

# **Jones, North, and South Rivers Salt Marsh Assessment**

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## Table of Contents

|   |           |
|---|-----------|
| <b>Introduction</b>   | <b>1</b>  |
| <b>Methods</b>  | <b>2</b>  |
| <b>Sampling Sites.</b>  | <b>2</b>  |
| North & South River Sites:                                      | 3         |
| <i>Chittenden (CH)</i>  | 3         |
| <i>Scituate Conservation (SC)</i>                               | 3         |
| <i>Driftway (DW)</i>  | 4         |
| <i>Trouant Island (TI)</i>                                      | 4         |
| <i>Coast Guard (CG)</i>   | 4         |
| <i>Rexhame (RX)</i>   | 4         |
| Jones River Sites:  | 5         |
| <i>Harbor Master (HM)</i>                                       | 5         |
| <i>Calista Property (CP)</i>                                    | 6         |
| <i>L Knife (LK)</i>   | 6         |
| <i>Jones River Landing (JL)</i>                                 | 6         |
| <b>Field Measurements</b>                                       | <b>8</b>  |
| Plant Community and Species (belt transect and point intercept) | 8         |
| Marsh Surface Bearing Capacity                                  | 10        |
| Root cores  | 11        |
| <b>Results and Discussion</b>                                   | <b>13</b> |
| <b>Plant Community and Species</b>                              | <b>13</b> |
| <b>Below Ground Biomass and Bearing Capacity</b>                | <b>18</b> |
| <b>Conclusions and Management Recommendations</b>               | <b>22</b> |

## Table of Figures

|   |    |
|---|----|
| Figure 1. Project Study Areas .....   | 3  |
| Figure 2. North and South River Sampling Sites .....  | 5  |
| Figure 3. Jones River Sampling Sites .....  | 7  |
| Figure 4. Transect Across Salt Marsh.....   | 9  |
| Figure 5. Collecting Bearing Capacity Data on the Salt Marsh .....  | 11 |
| Figure 6 Root Core Collected from Salt Marsh (note: above ground biomass was removed during processing) ..... | 12 |
| Figure 7. Belt Widths During the 2nd Sampling Event .....   | 15 |
| Figure 8. Belt Width comparison 2000 vs 2014 .....  | 16 |
| Figure 9. Mean Sea Level Trend (8443970 Boston, Massachusetts).....   | 17 |
| Figure 10. Interannual Sea Level Variation Since 1990 .....   | 18 |
| Figure 11. Below Ground Biomass in High and Low Marsh 2014 .....  | 19 |
| Figure 12. Bearing Capacity in Marsh Zones .....  | 20 |
| Figure 13. Ratio of Below Ground Biomass from High Marsh to Low Marsh .....                                   | 21 |
| Figure 14. Minimum Bearing Capacity per site vs Biomass Ratio.....  | 22 |

## Table of Tables

|   |    |
|---|----|
| Table 1. Dates of Sampling Events.....                                    | 7  |
| Table 2. Marsh acreage and equivalent number of transects per marsh ..... | 8  |
| Table 3. Marsh Size and Transect Details.....                             | 13 |
| Table 4. Percent Change From 2000 to 2014.....                            | 16 |

## Introduction

Salt marshes are critically important environmental resources, yet the health and even the existence of these habitats is imperiled throughout most of the United States. These highly productive systems provide numerous economic and environmental benefits, including protection of coastal properties and infrastructure from flooding, filtration of waterborne pollutants, habitat for dozens of aquatic, avian, and terrestrial species (including several important fishery species), and aesthetic and recreational enjoyment (Mitsch and Gosselink 2007). However, most salt marshes in the Northeast have historically been altered or destroyed by construction of ditches, dredging, fill and other hydrologic alterations, and those that remain are under intense pressure from nutrient pollution, shoreline development, and sea level rise (Kennish 2001).

It is estimated that Massachusetts has lost 41% of its pre-colonial salt marshes with that number as high as 80% in the Boston region (Bromberg and Bertness 2005). Given the vital importance of these habitats for the economic and environmental well-being of coastal communities, it is critical to monitor, protect, and restore the acres that remain. Marsh erosion and deterioration is a subject of critical concern, and may be caused or enhanced by multiple factors, including wave impacts, changes in sediment budgets, groundwater elevation and sea level rise (Fagherazzi et al., 2013).

In the Jones River, Kingston, MA, following the winter of 2012-2013 several local oystermen, fishermen, boaters, and residents reported rapid rates of marsh subsidence, erosion, and unusually frequent overtopping of the salt marsh. While anecdotal, these reports have come from multiple, knowledgeable, professionals with years of experience working in and around the Jones River and Kingston Bay. There is strong interest among the citizens and local stakeholders in pursuing these observations with more detailed scientific measurements to determine if in fact erosion and subsidence are occurring, and if so, identifying the rates and causes and any potential mitigation or remediation activities that may be attempted.

The North and South Rivers watershed is located north of the Jones River. All three of these rivers include typical New England coastal estuaries. In 2000-2001 six salt marsh sampling sites were established in the North to explore salt marsh zone width, total marsh width, species composition, plant density, plant length, and belowground biomass (Grady 2001). The current project revisited these sampling sites. These sites represent a significant opportunity to assess long-term changes (>decade) and trends in local salt marsh systems.

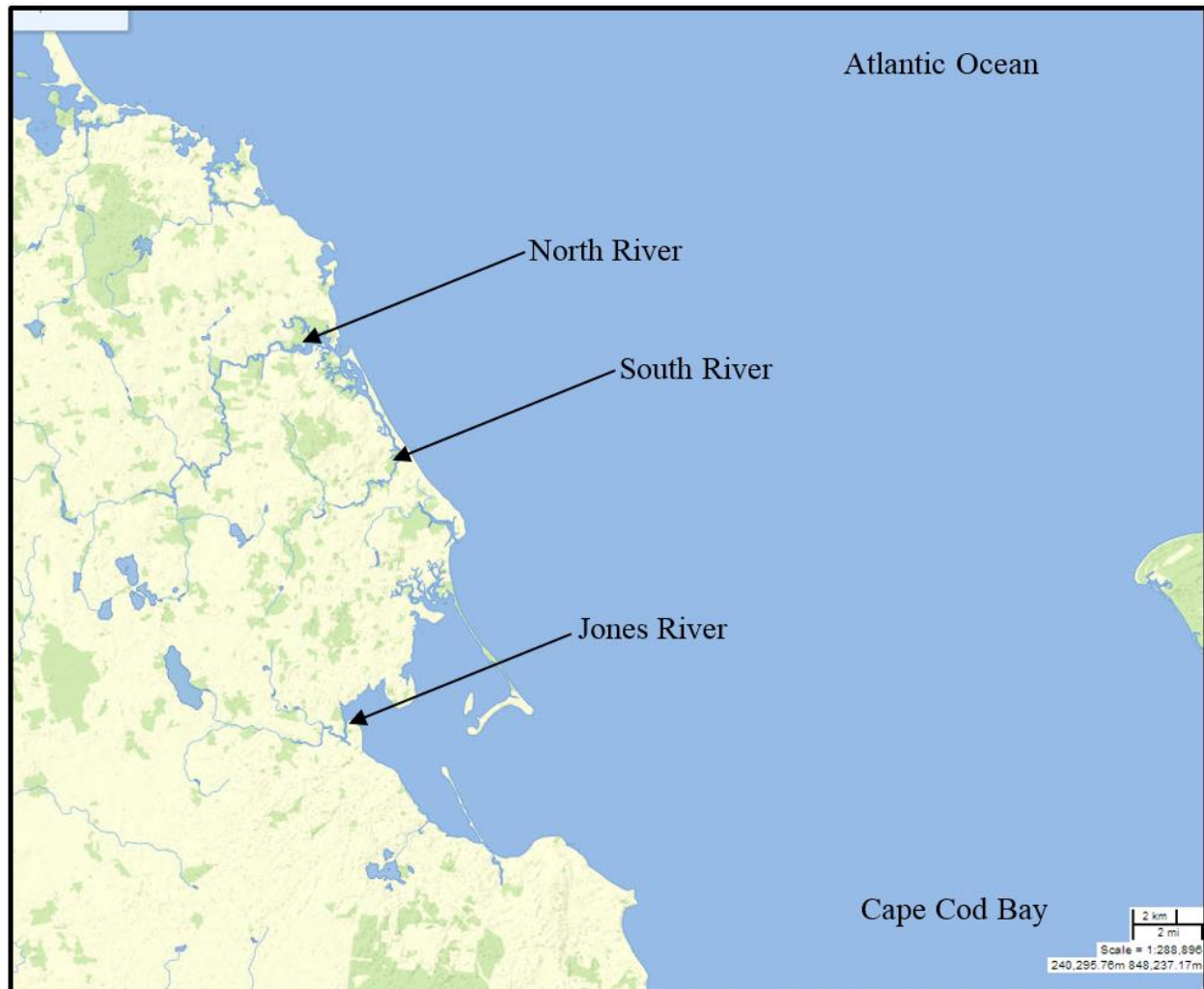
The North River and South River sites can serve as long-term regional benchmark as other nearby sites (e.g. Jones River) are established as long-term monitoring sites. Similar to the original site selection for North and South Rivers sampling, sites in the Jones River were selected to represent a range of representative marsh conditions. These included sites at the mouth of the estuary, mid estuary, and near the upstream extent of tidal intrusion. While all of the sites have seen some human alteration (ditching, etc) the sites ranged from heavily altered (Harbormaster) to relatively unaltered (Jones River Landing). The specifics of each site in all of the rivers are provided in the Methods section.

## Methods

All sampling and analytical methods follow the details defined in the Quality Assurance Project Plan (QAPP) approved by EPA (July 2014). The methods are summarized below.

### Sampling Sites.

Sampling sites in the North & South Rivers were replicates of the 2000-2001 study (Grady 2001). These provide a long-term evaluation of change in regional salt marshes. Sampling sites in the Jones River were selected to be representative of similar conditions as the sites in the North and South River. Four new salt marsh sampling sites were selected for the Jones River estuary. These sites were selected based on comparable features to the long-term sampling sites in the North & South Rivers. The sampling locations are shown in Figure 1-Figure 3 and the individual sites are described below.



*Figure 1. Project Study Areas*

#### North & South River Sites:

##### *Chittenden (CH)*

This site is a fringe marsh, which is quite narrow and borders a residential area. It is at the intersection of Second Herring Brook and the upper part of the North River. This area was used for shipbuilding in the 18th and 19th century and was the launch site of the last ship built on the North River, the “Helen M. Foster”, in 1871. It is now a Norwell Town Landing (NSRWA, 1997).

##### *Scituate Conservation (SC)*

This marsh, located midway along the North River on the northward side, is very wide with a few interspersed tributaries and ponds. Sediment at this site is always very soft and wet, which suggests that it is poorly drained. It is quite disturbed, bordered by a main road on the upland side, with a landfill across

that road, and a marina upstream. Various areas of the marsh and the surrounding dunes are covered in concrete left by the previous owner, the Boston Sand and Gravel Company, which launched sand and gravel barges from the site to support the construction of runways at Logan Airport in Boston. Today the town of Scituate owns 450 acres of the site that are designated as conservation land (NSRWA, 1997).

#### *Driftway (DW)*

This marsh is on the northward side of the North River almost at the point where it meets the South River. It is extensive and has many wide drainage ditches, and is bordered by the North River, dunes that separate it from the Atlantic, and an area that is a mix of woodlands, and residential use. The main 50-acre parcel belongs to the North and South Rivers Watershed Association (NSRWA 1997).

#### *Trouant Island (TI)*

The parcel of land southwest of the river mouth and slightly closer to the North River containing this site is 192 acres of tidal wetland owned by the Massachusetts Department of Fish & Game. It is a quite undisturbed, low nutrient concentration site with a small residential area on its border and a dirt road that splits the marsh into two halves, forming two smaller but still quite extensive marshes.

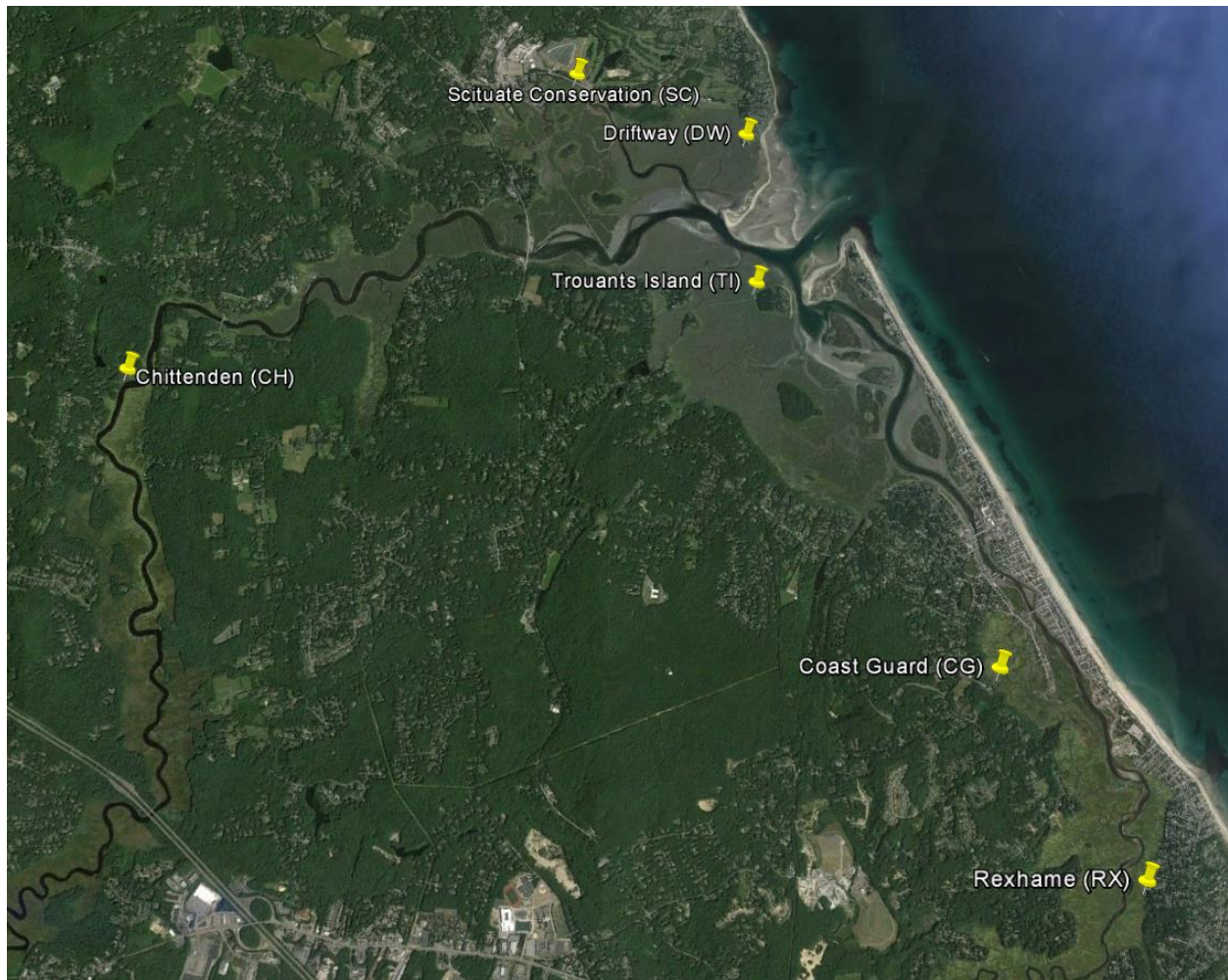
#### *Coast Guard (CG)*

This marsh is sandwiched between the residential area on the landward side of the South River and the residences of the Marshfield Hills, and is located on Clapp's Creek, which drains into the South River. This property is owned by the Marshfield Recreation Department. This was previously the Coast Guard Communications Center, which was built in 1943 to transmit weather information and track shipping along the Atlantic coast.

#### *Rexhame (RX)*

Located at the base of a hill that is almost entirely residential. This marsh is located on the South River just south of the point where the river changes course to flow northwest.





*Figure 2. North and South River Sampling Sites*

#### Jones River Sites:

##### *Harbor Master (HM)*

This small marsh is located at the mouth of the Jones River at the Kingston's Town Landing and boat ramp. The marsh is truncated on the North side by the town pier and on the West by the Harbormaster's office. The site is heavily altered by construction of the pier and harbormaster building. Natural processes (especially flow) at the site are also impacted the location of the solid pier adjacent to the marsh and the town slips in front. Significant flow from the confluence of the river and the bay impact the marsh site that is adjacent to the town slips, floats and pier. The marsh is generally sheltered from boat wakes but is impacted from stormwater runoff and the harbormaster's shack



### *Calista Property (CP)*

This marsh is located at the first bend in the Jones River where Smelt Brook enters from the Southeast. The property was purchased by the Town of Kingston in 2010 as part of a larger open space parcel. The site is bordered to the South by Massachusetts Bay Transportation Authority (MBTA) railroad tracks. In addition to the railroad the site shows signs of previous alternation where remnants of former piers exist, dating back to the 17<sup>th</sup> & 18<sup>th</sup> centuries. However, the site does not have any current human uses and is somewhat inaccessible. Significant alterations have not occurred in many decades.

### *L Knife (LK)*

Just upriver from the Calista Property the L. Knife site is also bordered on its upland edge by the MBTA railroad tracks. The site represents the mid-estuary in the Jones River. It has no significant freshwater sources although Route 3 storm water discharges at the site (just west of the transect). The site is on private property and is generally inaccessible except by boat.

### *Jones River Landing (JL)*

This marsh is located directly across the river from JRWA's offices at Jones River Landing Environmental Heritage Center. The site is bordered to the East by the Route 3 highway and on the South by the MBTA railway. The site was selected for its upstream location near the upstream extent of salt intrusion. While additional marsh area exists slightly further upstream it is either inaccessible or heavily impacted by development and invasive species. The JL site represents a relatively unimpacted upstream marsh habitat. The site is privately owned (same owner as the L Knife salt marsh)

Each site was sampled twice for plant community and bearing capacity. Root cores were collected on a third event at the end of the summer. The sampling dates are shown in Table 1.



Figure 3. Jones River Sampling Sites

Table 1. Dates of Sampling Events

| Sampling Site         | Species and Bearing<br>sampling #1 | Species and Bearing<br>sampling #2 | Root Core sampling |
|-----------------------|------------------------------------|------------------------------------|--------------------|
| <b>Jones River</b>    |                                    |                                    |                    |
| Harbor Master         | 7/1/2014                           | 8/14/2014                          | 10/2/2014          |
| Calista               | 7/1/2014                           | 8/15/2014                          | 9/22/2014          |
| L. Knife              | 7/1/2014                           | 8/14/2014                          | 9/22/2014          |
| Jones River Landing   | 6/30/2014                          | 8/14/2014                          | 9/24/2014          |
| <b>North River</b>    |                                    |                                    |                    |
| Trouants Island       | 7/2/2014                           | 7/31/2014                          | 10/2/2014          |
| Driftway              | 7/9/2014                           | 7/30/2014                          | 9/22/2014          |
| Scituate Conservation | 7/2/2014                           | 7/30/2014                          | 9/17/2014          |
| Chittenden Lane       | 7/29/2014                          | (only sampled once)                | 9/22/2014          |
| <b>South River</b>    |                                    |                                    |                    |
| Coast Guard           | 7/24/2014                          | 8/12/2014                          | 9/17/2014          |
| Rexhame               | 7/24/2014                          | 8/12/2014                          | 9/17/2014          |

## Field Measurements

### Plant Community and Species (belt transect and point intercept)

The number and location of transects were established in the office prior to field activities. The area of each marsh was determined in Google Earth. The acreage of the marsh determines the number of transects (Table 2). A random number generator was used to determine the location of each transect along the length of the marsh. Transects were conducted from the upland edge to the nearest open water. (Note: some transects were initially run in the opposite direction but all data has been normalized having the upland equal the start of the transect).

*Table 2. Marsh acreage and equivalent number of transects per marsh*

| Acres   | # transects |
|---------|-------------|
| 0-5     | 1           |
| 5-10    | 2           |
| 10-24   | 3           |
| 25-50   | 5           |
| 50-100  | 7           |
| 100-200 | 9           |

Along each transect plant zones or “belts” were determined based on the dominant (or co-dominant) plant species along the transect tape. As each transect was walked the beginning and ending of each plant zone was documented on the data form. Plant zones change when the dominant or co-dominant plant species changes. In addition to dominant species, belt boundaries were defined by pannes, pools, creeks, ditches, bare/mudflat, open water, or other physical features. Zones were measured to the nearest 0.25m. Measure zones of greater than 0.5m in width (Figure 4). Field data is included in Appendix A.

The point intercept measurement was conducted by documenting the species present at exactly every 10m along the transect. As each transect was walked for the plant community measurements (i.e belts), the vegetation was recorded starting at the initial point, every 10 m along the transect and at the end of the transect. If *Spartina alterniflora* was present, we measured the height of one representative leaf in centimeters.





*Figure 4. Transect Across Salt Marsh*

### Marsh Surface Bearing Capacity

Bearing capacity was measured along each transect in each major belt. Bearing capacity encompasses two indicators, loading response and penetration depth. Both are measured using a PVC tube and a penetrometer with a 5 Lbs. slide weight. Loading response is how deep the PVC tube and penetrometer sink into the marsh (measured in centimeters) when just the weight of the PVC tube and penetrometer are placed on the marsh surface (Figure 5). Loading response data provide a benchmark measurement of the minimum force the marsh peat is able to support. In addition, loading response provides an estimate of how decomposed the upper layers of the peat are.

Penetration depth is determined as the depth of the PVC tube after five blows. The penetration depth is intended to serve as a measure of below ground organic materials (greater amounts of below-ground organics should result in greater penetration resistance, or, conversely, the absence of organic material should result in greater penetration). Reductions in resistance reflect reductions in soil organic material which has been found to precede above-ground indicators of stress.





*Figure 5. Collecting Bearing Capacity Data on the Salt Marsh*

#### Root cores

Two root cores were taken at each site, one in the high marsh and one in the low marsh. Cores were collected using a PVC pipe with approximately a 5 cm interior diameter. The cores were collected to ~18cm deep (cut off at 10cm during processing). Cores were extruded from the corer into Whirl-Pak<sup>®</sup> bags and frozen at JRWA until processing (Figure 6).

Initial processing was conducted at JRWA. Each core was removed from the Whirl-Pak<sup>®</sup> bag, any stems and blades at the top/surface end of the core are trimmed off, and the cores cut to a length of 10 cm from the top. Cores were then thoroughly rinsed and broken up in a 50  $\mu$ m sieve until there was no visible soil remaining (i.e. water run through the root mass was clear). The rinsed root samples were brought to the MIT Sea Grant laboratory for drying (2 days at 65°) and weighing.





*Figure 6 Root Core Collected from Salt Marsh (note: above ground biomass was removed during processing)*



## Results and Discussion

The salt marshes in this study cover a broad range in size from 0.06 to 11 acres and transect lengths (i.e. marsh width) from 15m to 158m. Details of each marsh and transect are show in Table 3

Table 3. Marsh Size and Transect Details

| Sampling Site                        | Marsh Size (acres) | Number of Transects | Seaward Length of Marsh (m) | Location of Transect Along Length of Marsh (m) | Transect Lengths (m) |
|--------------------------------------|--------------------|---------------------|-----------------------------|--|----------------------|
| <b>Jones River Sites</b>             |                    |                     |                             |  |                      |
| Harbor Master                        | 0.37               | 1                   | 54                          | 25   | 48                   |
| Calista                              | 5.5                | 1                   | 240                         | 72   | 72                   |
| L. Knife                             | 3.4                | 1                   | 242                         | 227  | 58                   |
| Jones River Landing                  | 0.60               | 1                   | 34                          | 23   | 78                   |
| <b>North &amp; South River Sites</b> |                    |                     |                             |  |                      |
| Coast Guard                          | 10.98              | 3                   | 336                         | 87, 199, 311                                   | 152, 158, 62         |
| Chittenden Lane                      | 0.06               | 1                   | 39                          | 26   | 15                   |
| Driftway                             | 4.34               | 1                   | 341                         | 12   | 89                   |
| Rexhame                              | 8.37               | 2                   | 229                         | 55, 170  | 134, 140             |
| Scituate Conservation                | 3.75               | 1                   | 207                         | 120  | 67                   |
| Trouants Island                      | 2.48               | 1                   | 240                         | 96   | 36                   |

## Plant Community and Species

Data collected from the belt transect and point intercept surveys were parsed several ways. In general we found it most useful to use broad groupings of marsh type based on dominant species to use for cross-site comparisons. The following species were used as primary indicators:

- ***Spartina alterniflora* Tall Form (Tall Sa):** Indicates low marsh belts
- ***Spartina alterniflora* Short form (Short Sa):** Indicates transitional belts between the low and high marsh
- ***Spartina patens* (Sp):** Indicates the major high marsh belts
- ***Distichlis spicata* (Ds):** Also a high marsh plant. Separated out from Sp belts since it may be reflective of varying nutrient conditions or other marsh health indicators.
- ***Iva frutescens* (Iva):** The “high-tide bush” was used as an indicator of transitions to upland belts.

Other belt or characteristics that were considered included:

- **Pannes:** non or sparsely vegetated areas on the marsh surface. May include standing water, algal mats, etc.
- **Invasives:** Particularly *Phragmites australis*
- **Creeks:** Open water including natural creeks and man-made mosquito ditches.

Each site (except CH) was assessed twice in the summer of 2014 (Table 1). Comparison of the first and second visits revealed significant differences in the measurements of belt widths and locations as a result of different species emerging at different points in the season. This created some challenges to using all of the data from all events. As a result, we generally chose to use data from the second sampling round since we felt that the more mature plant communities were a more accurate representation. The use of early and late summer sampling events in the future may be useful in looking at seasonal development of the marshes and at long-term changes in timing of plant emergence. However, these aspects were not analyzed for this project. Using the 2<sup>nd</sup> round of sampling for all sites we looked at the percent cover for each belt type at each site (Figure 7). Note that transects vary significantly in length so the percent belt width represents a different absolute area for each site.

At individual sites the Low Marsh (*Tall Sa*) tended to make up <10% (mean = 6%) of the total marsh. When data was pooled across all sites Low Marsh made up 4% of the total marsh (note: this measure is lower than the individual data due to greater weighting of long transects in pooled data). The short form *S. alterniflora* (*Short Sa*) belts averaged 34% of each transects and *patens* (*Sp*) belts averaged 52%. However, this tradeoff between *Short Sa* and *Sp* showed noticeable differences between the North & South River and the Jones River sites. In the North & South Rivers the *Short Sa* belts were the dominant belt type averaging 47% of each site and made up 57% of the combined North & South belts. In the Jones the *Short Sa* averaged only 14% of each transect and 14% of the total. Conversely, in the Jones River the *Sp* belts were strongly dominate at an average of 73% of each transect and 74% of the total Jones River belts. While in the North & South *Sp* averaged only 38% of each transect and 36% of the combined transects. *Distichlis* and *Iva* made up small percentages of the transects with no noticeable differences in the two systems. Note that the apparently large percentage of these species at the Chittenden site is a product of the extremely short transects (15m), the actual width of this belt at CH was similar to other sites.

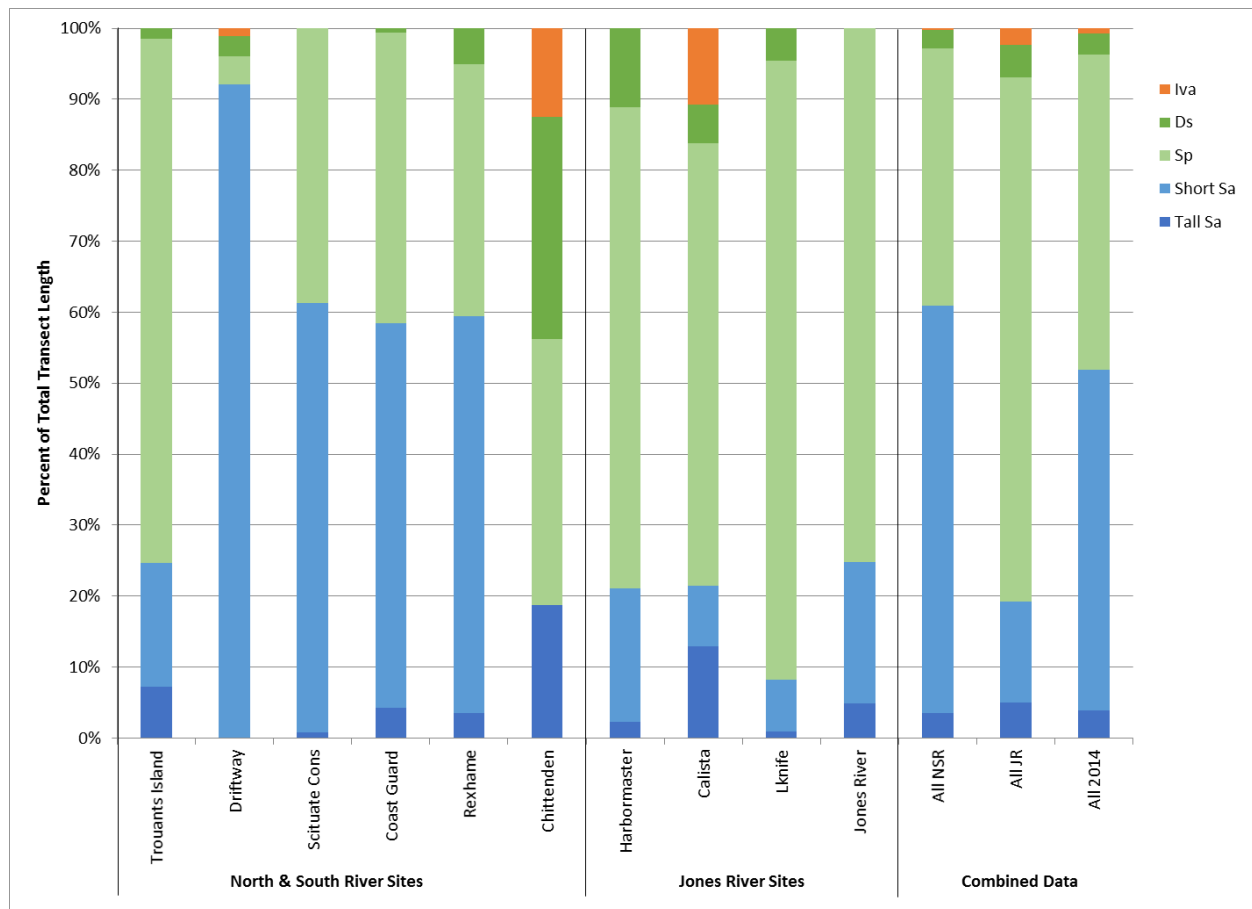


Figure 7. Belt Widths During the 2nd Sampling Event

The belt transect data from the 2<sup>nd</sup> round of 2014 sampling was also compared the older data (Grady 2001) for the revisited North & South River sites (Figure 8). In the fourteen years since the original sampling there has been a noticeable increase in the relative amount of short form *S. alterniflora* that has come mostly at the expense of *S. patens*. As seen in Table 4 increases in short form *S. alterniflora* were seen at 4 out of 6 sites and in each case that was accompanied by a comparable decrease in *S. Patens*. In 2001 *S. patens* represented the largest portion of the individual transects at an average of 62% per site and at a total of 65% for all combined sites. Note: the combined value gives a sense of the species makeup across all sites within each river as opposed the individual transect within a marsh section. Short form *S. alterniflora* made up only an average of 19% per site. In 2014 that dominance has shifted to short form *S. alterniflora* which now makes up an average of 47% per site and a total of 48% across all sites. *S. patens* has diminished to an average of 38% per site and 44% of all sites.

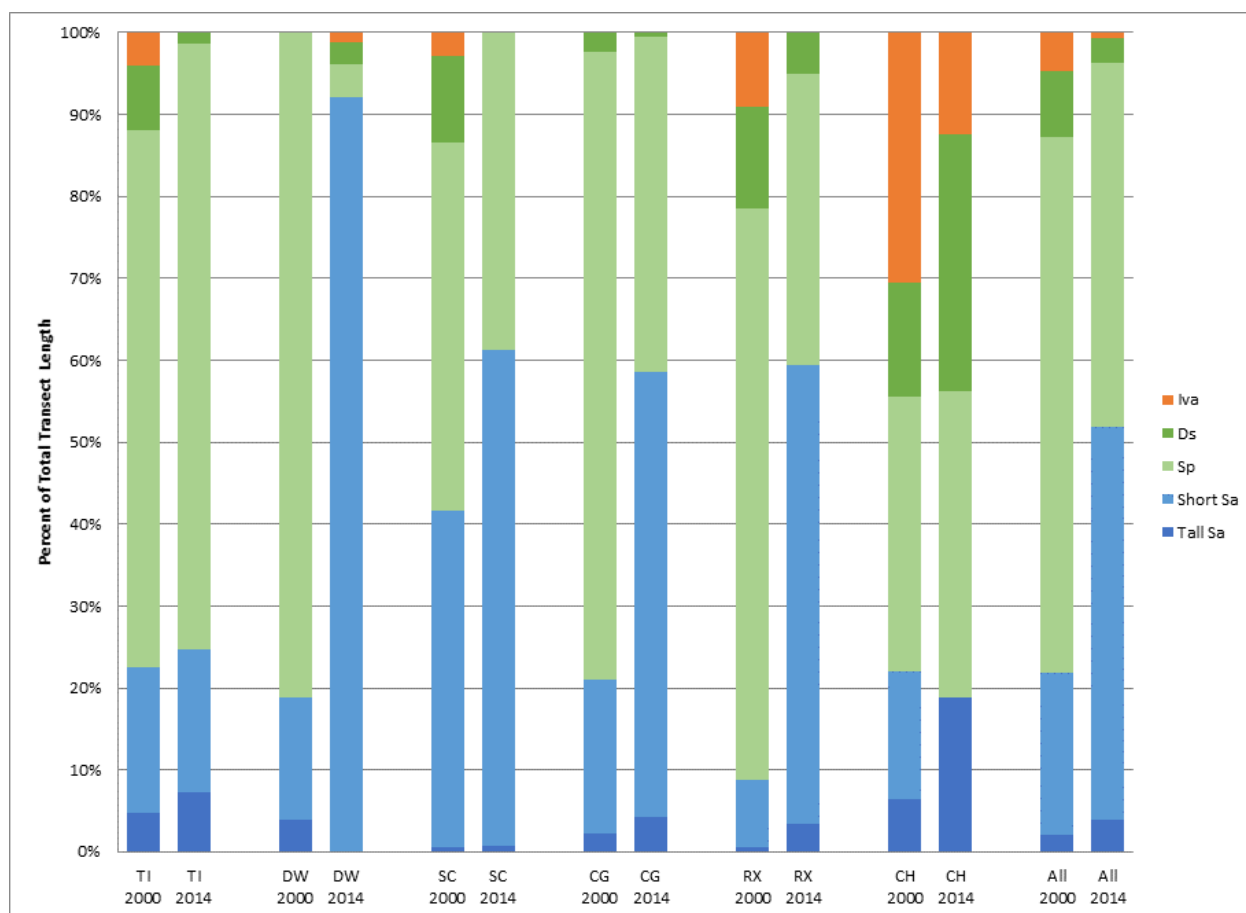


Figure 8. Belt Width comparison 2000 vs 2014

Table 4. Percent Change From 2000 to 2014

|     | Tall Sa | Short Sa | Sp   | Ds   | Iva  |
|-----|---------|----------|------|------|------|
| SC  | 1%      | 16%      | -3%  | -11% | -3%  |
| CH  | 12%     | -16%     | 4%   | 17%  | -18% |
| CG  | 1%      | 42%      | -41% | -2%  | 0%   |
| RX  | 4%      | 49%      | -39% | -5%  | -9%  |
| DW  | -4%     | 81%      | -81% | 4%   | 0%   |
| TI  | 1%      | -4%      | 13%  | -5%  | -4%  |
| All | 2%      | 40%      | -33% | -4%  | -4%  |

The shift in species composition from *S. patens* to *S. alterniflora* (short form) may be an indicator of increased salinity on the marsh as a result of more frequent inundation. While *Spartina patens* can tolerate occasional salt water inundation (a few times per month) it does not thrive where high salinities are more frequent and where sediment oxygen levels are decreased in the lower marsh. In these areas *S. Opatens* is

usually outcompeted by *S. alterniflora*. Local tidal data suggests that increased inundation of the marshes may be occurring. Figure 9 shows monthly mean sea level at the Boston tidal station 8443970 from 1921 to present (taken from NOAA <http://tidesandcurrents.noaa.gov/>). The mean sea level trend at this station has been an increase of 2.80 (+/-0.17mm) millimeters per year. This would mean an approximate increase of 3.6cm between the surveys of 2001 and 2014. In addition to the long-term trend of increasing sea level, there is interannual variation in sea level caused by irregular fluctuations in coastal ocean temperatures, salinities, winds, atmospheric pressures, ocean currents, and other factors. Figure 10 shows the interannual variation of monthly mean sea level and the 5-month running average at Boston tidal station 8443970 since 1990 with the average seasonal cycle and linear sea level trend removed (taken from NOAA <http://tidesandcurrents.noaa.gov/>). The interannual variation has been characterized by generally higher than average sea level since 2009. With only two sampling events from 2001 to 2014 it is difficult to discern if the long-term trend or short-term anomaly is playing the larger role in species composition change. However, this may not be critical to tease apart. The recent elevated sea levels resulting from the interannual variation may be considered a preview of conditions expected to result from the long-term sea level trend.

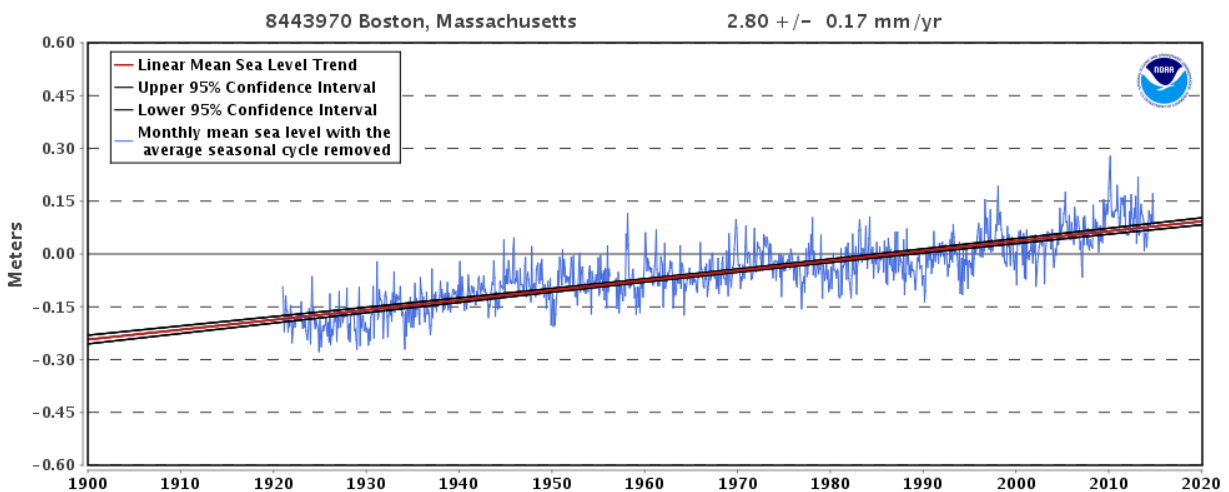


Figure 9. Mean Sea Level Trend (8443970 Boston, Massachusetts)

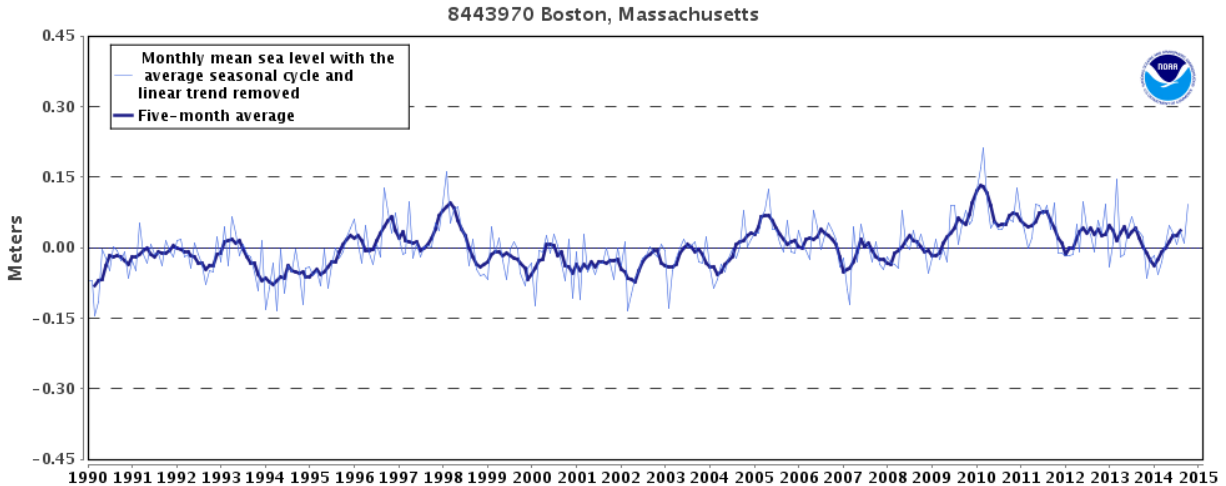


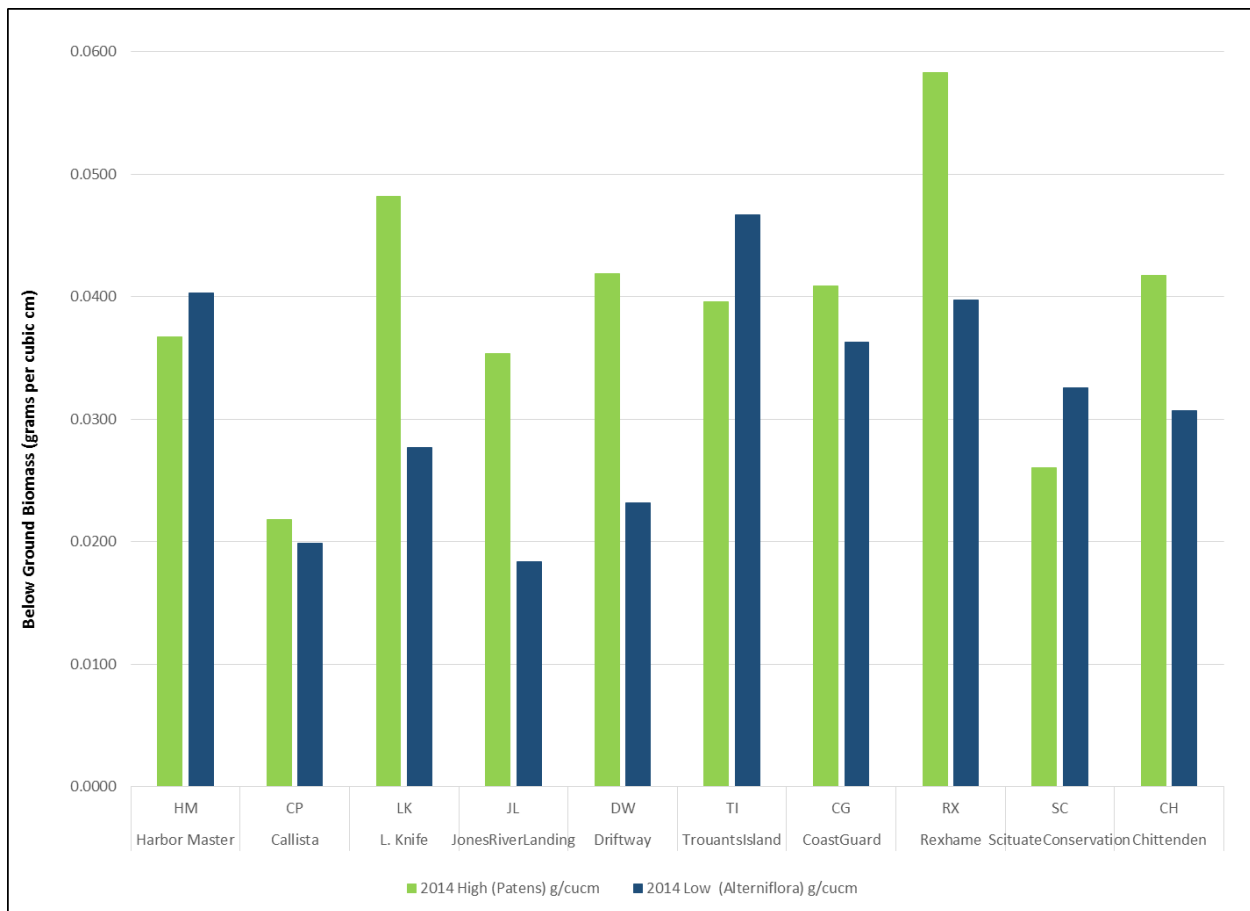
Figure 10. Interannual Sea Level Variation Since 1990

The Jones River species composition is especially interesting in the context of the changes seen in the North & South Rivers from 2001 to 2014. The 2014 Jones River species composition looks more similar the North & South River data from 2001 than from 2014 (Figure 7). Without earlier Jones River data it is difficult to know if there is any significance to this observation. However, it does suggest that shifts in *Spartina patens* vs *Spartina alterniflora* would be a key indicator to monitor as part of a long-term salt marsh monitoring program in the Jones River.

### Below Ground Biomass and Bearing Capacity

Below ground biomass can be an indicator of salt marsh health. In general high biomass represents strong healthy marshes. Bearing capacity has been used as a proxy measure for below ground biomass, where high bearing capacity (measured as low penetration) is indicative of high below ground organic materials. I.e. greater amounts of below-ground organics should result in greater resistance to penetration, or, conversely, the absence of organic material should result in greater penetration. Reductions in resistance reflect reductions in soil organic material which has been found to precede above-ground indicators of stress. (Twohig and Stolt 2011; Carullo et al. 2007).

Below ground biomass at all sites for 2014 is shown in Figure 11. At most sites biomass is higher in the high marsh than in the low marsh. This is generally expected since the low marsh is harsher environment including river currents, wave action, greater and more frequent salinity changes, etc. In many cases is the low marsh is breaking away into the rivers and does not support long-term root development.



*Figure 11. Below Ground Biomass in High and Low Marsh 2014*

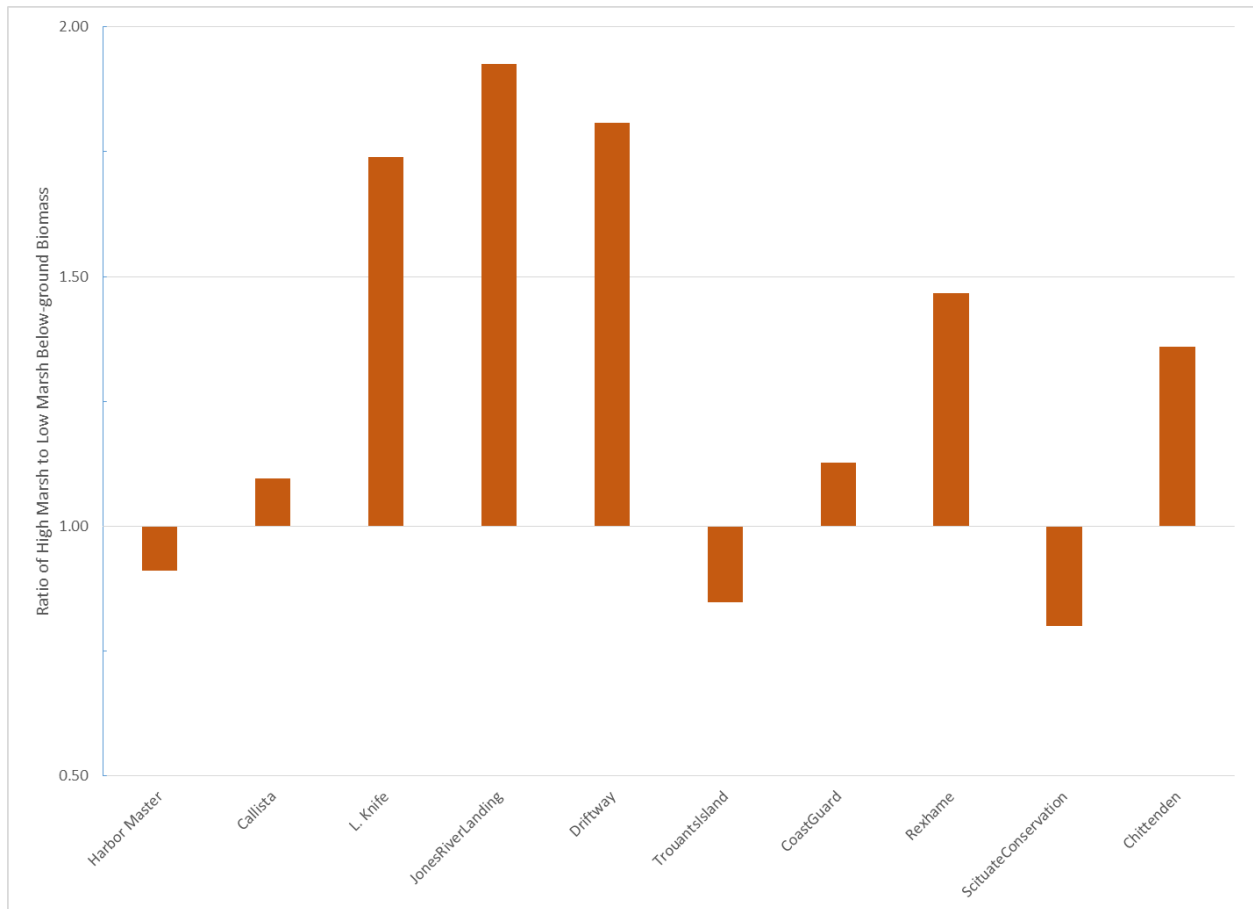
Bearing capacity was measured at all sites across a range of marsh types along each transect. Similar to the belt transect data marsh type was lumped into broad categories. Slightly different categories were used for the bearing capacity data than the plant community data. In this case species type was less important, so the lumped categories included: Low marsh, Transitional, High Marsh, and Pannes. Figure 12 shows the bearing capacity in each zone. As expected bearing capacity (like below ground biomass) decreases from high to low marsh. There were only a few pannes encountered across all sites. Of the four that were sampled for bearing capacity there was a wide range of results that included the second lowest bearing capacity as well as the highest. This was the result of a difference the panne properties. The panne with very low bearing capacity had virtually no vegetation and was predominately soft mud. The pannes with higher bearing capacity had some, mostly dead, vegetation. It is likely that these are more recently formed pannes that may transition over time to having less vegetation.



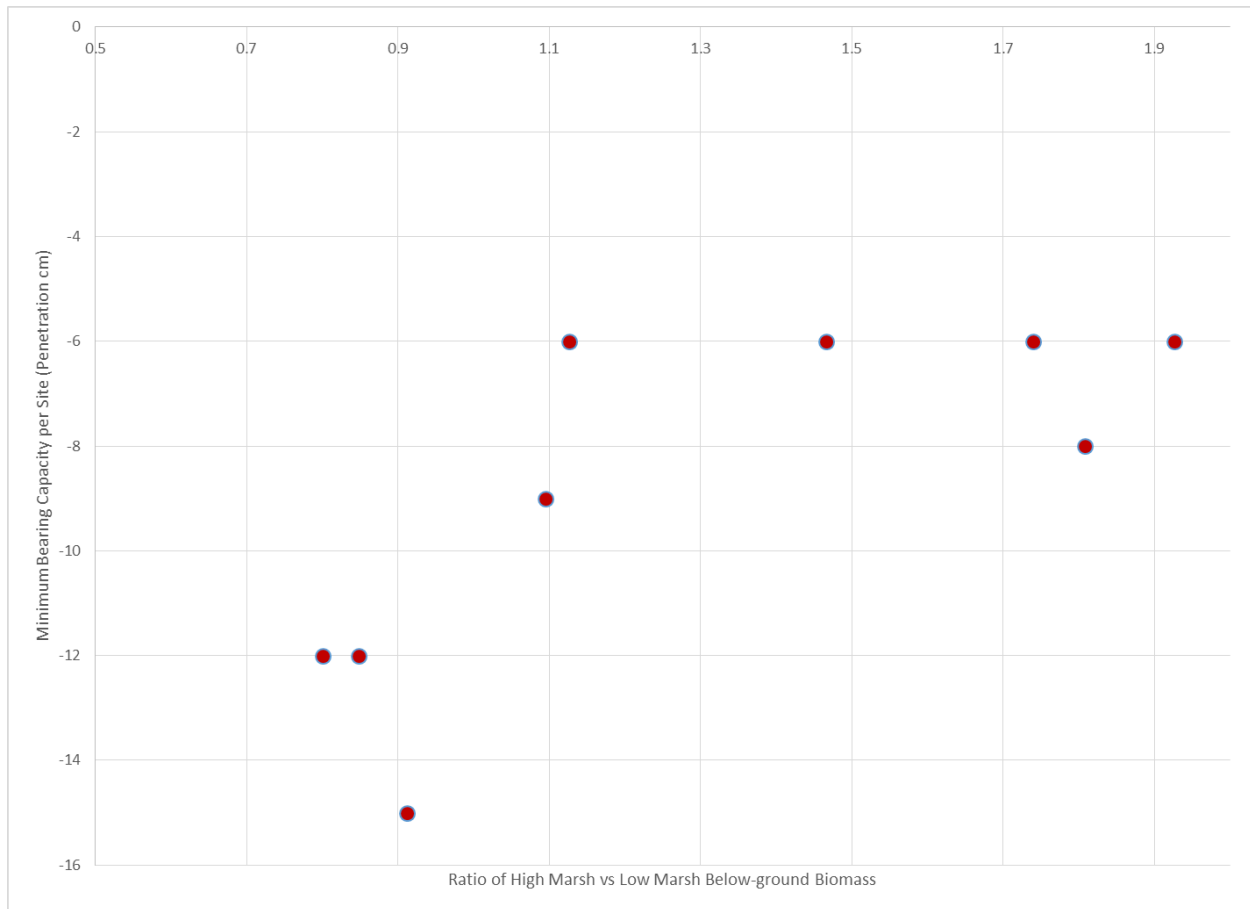


Figure 12. Bearing Capacity in Marsh Zones

Another way to consider the relationship between high and low marsh biomass is as a ratio. The same data from Figure 11 is presented in Figure 13 as ratios of below ground biomass in the high marsh vs low marsh. Ratios  $>1$  indicate that below ground biomass is greater in the high marsh than in the low marsh. Ratios  $<1$  indicate that below ground biomass is greater in the low marsh. In most cases, sites that had robust *Spartina patens* high marsh had larger positive ratios. This ratio may be useful as an index of marsh health. With these ratios in mind we compared the minimum bearing capacity (i.e. greatest penetration) at each site to the biomass ratio at that site. Figure 14 shows that comparison. In general, bearing capacity was correlated to high:low biomass ratio. This supports the use of either of these measures as an indicator of relative marsh health.



*Figure 13. Ratio of Below Ground Biomass from High Marsh to Low Marsh*



*Figure 14. Minimum Bearing Capacity per site vs Biomass Ratio*

## Conclusions and Management Recommendations

Overall the marshes sampled in this study are in generally good health. There are no major die-back events, no extensive salt pannes, limited invasive species, robust plant density and growth, etc. While there were changes observed from 2001 to 2014 there was neither significant loss of marsh nor major transitions to degraded marsh surfaces. In the Jones River there was no opportunity to compare to historic data, but plant communities were typical of healthy salt marshes. Features such as pannes can often be an indicator of marshes in decline yet very few pannes were encountered across all of the sites.

The comparison of 2001 vs 2014 measurements in the North and South Rivers does suggest changes that are indicative of increased inundation. The interannual variability data for the region shows that for the past ~5 years we have been in a period of higher than average sea levels. This is part of a long-term oscillation. Species composition in the marshes may be responding to this increased inundation between

the 2001 and 2014 sampling events. It may be a relatively short-term response (5-10 years) if it is related to the oscillation. However, long-term trends in sea level are also increasing. Even if the change in species composition is exacerbated in the short-term by the interannual oscillation this may be a preview of marsh development in the longer term with elevated sea levels.

The Jones River Sites do not have the benefit of previous monitoring that would allow for detecting change. The 2014 sampling therefore will serve as a baseline for future efforts. However, comparison between the Jones River the North and South Rivers showed that species composition in the 2014 Jones River sampling was more similar to the North and South Rivers in 2001 than in 2014. Tracking the two marsh systems in a coordinated monitoring effort going forward may help determine if this relationship is real, and if so what are the controlling factors. For example if changes in the North and South Rivers system are advancing ahead of the Jones River it may provide an early warning for Jones River conditions. Conversely, if the Jones River marshes are found to be more stable over time it may provide insight towards managing for resiliency in the North and South Rivers.

The changes seen over the past thirteen years combined with observed and projected sea level rise indicate the benefit of a long-term salt marsh monitoring program for these two systems. In addition to focusing on these local systems it would be useful to tie into other monitoring programs in the region and beyond. Based on the results of this study and considering cost, effort, and logistics a simple but effective monitoring program would include:

- Species composition (i.e. belt width) transects. This is a relatively simple, low cost method that showed the greatest detail in terms of marsh status and trends. Our twice per year approach was problematic in that early season measurements may not have been indicative of the full grow out on the marsh. Therefore a once per year approach would save resources while generating the same (or better) data quality. Sampling at two to five year intervals would likely capture long-term trends and shorter term variability.
- Below ground biomass and bearing capacity for select marshes. Below ground biomass measurements can be a good indicator of marsh health and resiliency that cannot be determined through above ground species identification alone. However, the biomass measurements are more intensive in that they require some laboratory analysis. There may also be considerable variability across the marsh that isn't captured by 2 samples per site. Therefore it may be more effective to conduct this method at longer intervals (5-10 years), at fewer sites, and more intensively (multiple samples with replicates). Bearing capacity may be used as a proxy for

below ground biomass. This relatively simple and low cost method could be used in conjunction with the species composition surveys (2-5 years).

- High resolution elevation surveys. For this project we did not conduct elevation measurements. This could be an extremely valuable way to assess marsh health, trends, and influences. Technologies such as Real Time Kinematic (RTK) Global Positioning Systems (GPS) have become increasingly cost effective, user friendly, and accessible. These systems can provide horizontal and vertical accuracy to <5cm. Mapping salt marsh transects to this accuracy will help define the vulnerability to changes in sea level as well as long-term changes in marsh elevation.
- Remote sensing systems. Field based monitoring programs are limited by season, access, cost, and logistics. Additionally, they capture only a snapshot of the conditions on the sampling date. For example, above we recommended a monitoring frequency of two to five to ten years with a one sampling per event. While this is useful for tracking long-term trends, interannual variability in climatic conditions and other factors can result in significant variation between these ‘snapshots’. Remote sensing tools can provide higher temporal resolution to complement the traditional field monitoring program. Loggers for water level, salinity, temperature, light, etc can be deployed at select monitoring sites to capture short-term (<daily) conditions. Remote cameras that also provide high resolution visual data can be combined with traditional field survey. Development of such camera systems is a component of the current project that will be reported separately.
- Modeling tools. Worldwide recognition of the importance of salt marshes and of their tenuous status in light of sea level rise has lead the development of a number of planning tools. For example the new Marsh Analysis and Planning Tool Incorporating Tides and Elevations (MAPTITE) <http://tidesandcurrents.noaa.gov/maptite.html> was developed by NOAA for coastal restoration planning. This tool incorporates vegetation types, elevations, tides, etc. While the tool is designed for restoration purposes it is also useful for considering existing marshes and evaluating their future under changing conditions.

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# **Appendix A**

## **Field Data**



|  |                                |                  |               |  |               |                   |               |  |               |                   |               |  |               |
|--|--------------------------------|------------------|---------------|--|---------------|-------------------|---------------|--|---------------|-------------------|---------------|--|---------------|
| Marsh ID: Calista  | Date: July 1, 2014             |                  |               |  |               |                   |               |  |               |                   |               |  |               |
|  | Time Start: 2:17 Finish:       |                  |               |  |               |                   |               |  |               |                   |               |  |               |
| Field Personnel:<br>Alex Mansfield<br>Victoria Hughes<br>Mike McMahon  | Weather:<br>sunny, breezy, hot |                  |               |  |               |                   |               |  |               |                   |               |  |               |
| Seaward Length of site (m):  | Acreage of Site .              |                  |               |  |               |                   |               |  |               |                   |               |  |               |
| Random # start point (m): 72m  | Heading of Transect: 223°      |                  |               |  |               |                   |               |  |               |                   |               |  |               |
| <p>Notes:</p> <p>Coordinates-</p> <table> <tr> <td>Waypoint CP - 0E</td> <td>N 41° 59.560'</td> </tr> <tr> <td></td> <td>W 70° 42.599'</td> </tr> <tr> <td>Waypoint CP - 72E</td> <td>N 41° 59.591'</td> </tr> <tr> <td></td> <td>W 70° 42.752'</td> </tr> <tr> <td>Waypoint CP - 72U</td> <td>N 41° 59.559'</td> </tr> <tr> <td></td> <td>W 70° 42.792'</td> </tr> </table> |                                | Waypoint CP - 0E | N 41° 59.560' |  | W 70° 42.599' | Waypoint CP - 72E | N 41° 59.591' |  | W 70° 42.752' | Waypoint CP - 72U | N 41° 59.559' |  | W 70° 42.792' |
| Waypoint CP - 0E   | N 41° 59.560'                  |                  |               |  |               |                   |               |  |               |                   |               |  |               |
|  | W 70° 42.599'                  |                  |               |  |               |                   |               |  |               |                   |               |  |               |
| Waypoint CP - 72E  | N 41° 59.591'                  |                  |               |  |               |                   |               |  |               |                   |               |  |               |
|  | W 70° 42.752'                  |                  |               |  |               |                   |               |  |               |                   |               |  |               |
| Waypoint CP - 72U  | N 41° 59.559'                  |                  |               |  |               |                   |               |  |               |                   |               |  |               |
|  | W 70° 42.792'                  |                  |               |  |               |                   |               |  |               |                   |               |  |               |

|   |   |
|---|---|
| Marsh ID: Harbor Master   | Date: July 1, 2014  |
|   | Time Start: 11:44 Finish:                                       |
| Field Personnel:<br>Alex Mansfield<br>Victoria Hughes<br>Mike McMahon   | Weather:<br>85 deg. celsius<br>Partly Cloudy, Hazy<br>No Breeze |
| Seaward Length of site (m): 54  | Acreage of Site .37   |
| Random # start point (m): 25m   | Heading of Transect: 280°                                       |
| <p>Notes:</p> <p>Coordinates- Marsh Edge 0    N 41° 59.860'    Waypoint<br/>          W 70° 42.599'    HM-0E</p> <p>Random #1 Start Point- Photo Taken<br/>                                        broken marsh edge/inlet</p> <p>Heading Adjusted slightly to capture full length of marsh<br/>                                        - Harbormaster building/wall/bush impedes original heading</p> <p>Waypoint HM-25E    N 41° 59.865'<br/>          W 70° 42.600'</p> <p>Waypoint HM-25U</p> |   |

|   |                               |
|---|-------------------------------|
| Marsh ID: L. Knife  | Date: July 1, 2014            |
|   | Time Start: 4:18 Finish:      |
| Field Personnel:<br>Alex Mansfield<br>Victoria Hughes<br>Mike McMahon   | Weather:<br>sunny, WINDY, hot |
| Seaward Length of site (m): 242   | Acreage of Site .             |
| Random # start point (m): 227m  | Heading of Transect: 210°     |
| <p>Notes:</p> <p>Coordinates-</p> <p>Waypoint LK - 0E                      N 41° 59.603’<br/>    W 70° 42.903’</p> <p>Waypoint LK - 227E                      N 41° 59.668’<br/>    W 70° 43.041’</p> <p>Waypoint LK - 227U                      N 41° 59.642’<br/>    W 70° 43.063’</p> <p>lowering SA seadheads</p> |                               |

[illegible]

|  |                           |
|--|---------------------------|
| Marsh ID: DW   | Date: July 9, 2014        |
|  | Time Start: 12:59 Finish: |
| Field Personnel:<br>Sara Grady<br>Victoria Hughes<br>Mike McMahon  | Weather:<br>hot windy     |
| Seaward Length of site (m): 341  | Acreage of Site 4.34      |
| Random # start point (m): 12m  | Heading of Transect: 230° |
| <p>Notes:</p> <p>Coordinates-</p> <p>Waypoint DW - 12U                      N 42° 10' 16.3"</p> <p>    W 70° 43' 7"</p> <p>transect ends at a side creek</p> |                           |

|   |                                |
|---|--------------------------------|
| Marsh ID: SC Scituate Conservation  | Date: July 1, 2014             |
|   | Time Start: 2:17 Finish:       |
| Field Personnel:<br>Alex Mansfield<br>Victoria Hughes<br>Mike McMahon   | Weather:<br>sunny, breezy, hot |
| Seaward Length of site (m): 207   | Acreage of Site 3.75           |
| Random # start point (m): 120m  | Heading of Transect: 206°      |
| <p>Notes:</p> <p>Coordinates-</p> <p>Waypoint SC - 120E                      N 42° 10' 32.08"</p> <p>    W 70° 44' 18.01"</p> <p>stake begins 2 m after edge bare edge sloped down from grassy edge</p> |                                |

**Table 1. Marsh Transects with Point Intercept Data**

| Date      | Marsh ID | Transect | Start | End | Belt Width (m) | Dominant Sp.  | Codominant | Other Sp.       | Community Type                | Community Group | Coordinates and Notes  |
|-----------|----------|----------|-------|-----|----------------|---------------|------------|-----------------|-------------------------------|-----------------|--|
| 7/1/2014  | Calista  | 72       | 0     | 2   | 2              | Sa tall       |            |                 | Low marsh                     | LowSa           |  |
| 7/1/2014  | Calista  | 72       | 2     | 6   | 4              |               | Sa/Sp      |                 | Sa type 1                     | Transitional    |  |
|           |          |          |       |     |                |               |            |                 |                               |                 |  |
| 7/1/2014  | Calista  | 72       | 6     | 11  | 5              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |
| 7/1/2014  | Calista  | 72       | 11    | 31  | 20             | Sp            |            | Sa short        | Perennial Turf Grass Type 2   | Panne           | looks like salt panne - no standing water. Old algae growth, SP dead |
| 7/1/2014  | Calista  | 72       | 31    | 43  | 12             | Sp            |            | Salitwort       | Perennial Turf Grass Type 1   | HighSp          | old salt panne extension, dry now                                    |
| 7/1/2014  | Calista  | 72       | 43    | 49  | 6              | Sa tall       |            | Sp              | Low marsh                     | SaCreek         | mosquito ditch in center   |
| 7/1/2014  | Calista  | 72       | 49    | 59  | 10             | Sp            |            | Sa short (some) | Perennial Turf Grass Type 2   | HighSp          | enter connected mosquito ditch                                       |
| 7/1/2014  | Calista  | 72       | 59    | 63  | 4              | Sa            |            |                 | Sa type 1                     | Creek           | in ditch   |
| 7/1/2014  | Calista  | 72       | 63    | 73  | 10             | Sp iva juncus |            |                 | Salt Marsh Terrestrial Border | Border          | everything pretty much dead  |
| 8/15/2014 | Calista  | 72       | 0     | 4   | 4              | Sa            |            |                 | Low marsh                     | LowSa           |  |
| 8/15/2014 | Calista  | 72       | 4     | 6   | 2              |               | Sa/Sp      |                 | Sa type 1                     | Transitional    |  |
| 8/15/2014 | Calista  | 72       | 6     | 11  | 5              | Sp            |            | JG              | Perennial Turf Grass Type 1   | HighSp          |  |
| 8/15/2014 | Calista  | 72       | 11    | 25  | 14             | dead          |            |                 | Pannes                        | PanneBare       |  |
| 8/15/2014 | Calista  | 72       | 25    | 30  | 5              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |
| 8/15/2014 | Calista  | 72       | 30    | 32  | 2              | Sa            |            |                 | Pannes                        | MidSa           |  |
| 8/15/2014 | Calista  | 72       | 36    | 37  | 1              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |
| 8/15/2014 | Calista  | 72       | 37    | 41  | 4              | dead          |            |                 | Pannes                        | PanneBare       |  |
| 8/15/2014 | Calista  | 72       | 41    | 43  | 3              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |
| 8/15/2014 | Calista  | 72       | 43    | 45  | 2              | Sa tall       |            |                 | Low marsh                     | Creek           |  |
| 8/15/2014 | Calista  | 72       | 45    | 50  | 5              | Sp            |            | Salii, Sa, Ds   | Perennial Turf Grass Type 2   | HighSp          | 47.2 stream  |
| 8/15/2014 | Calista  | 72       | 50    | 53  | 3              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |
| 8/15/2014 | Calista  | 72       | 53    | 55  | 2              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |
| 8/15/2014 | Calista  | 72       | 55    | 57  | 2              | Sp            |            |                 | Perennial Turf Grass Type 1   | HighSp          |  |



|           |                |    |    |    |    |                |       |                    |                                  |              |  |
|-----------|----------------|----|----|----|----|----------------|-------|--------------------|----------------------------------|--------------|--|
| 8/15/2014 | Calista        | 72 | 57 | 59 | 2  | dead           |       | Sp Ds              | Perennial Turf<br>Grass Type 1   | HighCoD      |  |
| 8/15/2014 | Calista        | 72 | 59 | 60 | 1  | Ds             |       | Sp                 | Perennial Turf<br>Grass Type 1   | HighDs       |  |
| 8/15/2014 | Calista        | 72 | 60 | 65 | 5  | Ds Sp          |       |                    | Perennial Turf<br>Grass Type 1   | HighCoD      |  |
| 8/15/2014 | Calista        | 72 | 65 | 69 | 4  | Ds             |       | Sp                 | Perennial Turf<br>Grass Type 1   | HighDs       |  |
| 8/15/2014 | Calista        | 72 | 69 | 72 | 3  | wrak           |       |                    | Salt Marsh<br>Terrestrial Border | Border       |  |
| 7/29/2014 | CH lane        | 26 | 0  | 4  | 4  | Sp             |       | Ds fox<br>grape    | Salt Marsh<br>Terrestrial Border | HighSp       |  |
| 7/29/2014 | CH lane        | 26 | 4  | 6  | 2  | IVA            |       | fox grape<br>Ds Sp | Salt Marsh<br>Terrestrial Border | Border       |  |
| 7/29/2014 | CH lane        | 26 | 6  | 11 | 6  | Ds             |       | Sp                 | Perennial Turf<br>Grass Type 1   | HighDs       |  |
| 7/29/2014 | CH lane        | 26 | 11 | 12 | 1  |                | Ds/Sp | Sa                 | Perennial Turf<br>Grass Type 2   | HighCoD      |  |
| 7/29/2014 | CH lane        | 26 | 12 | 13 | 1  | Sp             |       | Sa Ds              | Perennial Turf<br>Grass Type 2   | HighSp       |  |
| 7/29/2014 | CH lane        | 26 | 13 | 14 | 2  | Sa             |       |                    | Sa type 1                        | LowSa        |  |
| 7/24/2014 | Coast<br>Guard | 87 | 0  | 12 | 12 | Sedge          |       | NL CAT<br>Phrag    | Invasives                        | Border       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 12 | 15 | 3  | Sedge<br>Wrack |       | Phrag              | Invasives                        | Border       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 15 | 15 | 1  | Wrack          |       |                    | Mud flat/bare                    | Border       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 15 | 16 | 1  | Bare           |       | ALT Sali           | Mud flat/bare                    | PanneBare    |  |
| 7/24/2014 | Coast<br>Guard | 87 | 16 | 20 | 4  | Sa             |       | Sp                 | Sa type 1                        | MidSa        |  |
| 7/24/2014 | Coast<br>Guard | 87 | 20 | 22 | 2  | Sp             |       | Sa                 | Perennial Turf<br>Grass Type 2   | HighSp       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 22 | 26 | 5  | Sa             |       | Sp                 | Sa type 1                        | MidSa        |  |
| 7/24/2014 | Coast<br>Guard | 87 | 26 | 31 | 5  | Sp             |       |                    | Perennial Turf<br>Grass Type 1   | HighSp       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 31 | 32 | 1  | Sp             |       | Sa                 | Perennial Turf<br>Grass Type 2   | HighSp       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 32 | 33 | 1  | Creek,<br>Sa   |       |                    | Ditch                            | SaCreek      |  |
| 7/24/2014 | Coast<br>Guard | 87 | 33 | 48 | 15 | Sa             |       | Sp                 | Sa type 1                        | MidSa        |  |
| 7/24/2014 | Coast<br>Guard | 87 | 48 | 61 | 13 |                | Sa/Sp |                    | Sa type 1                        | Transitional |  |
| 7/24/2014 | Coast<br>Guard | 87 | 61 | 76 | 16 | Sp             |       | Sa Sali            | Perennial Turf<br>Grass Type 2   | HighSp       |  |
| 7/24/2014 | Coast<br>Guard | 87 | 76 | 84 | 8  | Sa             |       | Sp Sali            | Sa type 1                        | MidSa        |  |

|           |             |     |     |     |    |           |            |            |                             |              |  |
|-----------|-------------|-----|-----|-----|----|-----------|------------|------------|-----------------------------|--------------|--|
| 7/24/2014 | Coast Guard | 87  | 84  | 88  | 5  |           | Sa/Sp      |            | Sa type 1                   | Transitional |  |
| 7/24/2014 | Coast Guard | 87  | 88  | 91  | 3  | Sa        |            | Sali Sp    | Sa type 1                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 87  | 91  | 101 | 10 | Sp        |            | Ds Sa      | Perennial Turf Grass Type 2 | HighSp       |  |
| 7/24/2014 | Coast Guard | 87  | 101 | 114 | 13 | Sp        |            | Ds         | Perennial Turf Grass Type 1 | HighSp       |  |
| 7/24/2014 | Coast Guard | 87  | 114 | 117 | 3  | Sp        |            | Ds Sa Sali | Perennial Turf Grass Type 2 | HighSp       |  |
| 7/24/2014 | Coast Guard | 87  | 117 | 118 | 2  | Sa        |            |            | Sa type 1                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 87  | 118 | 124 | 6  | Creek, Sa |            |            | Ditch                       | SaCreek      |  |
| 7/24/2014 | Coast Guard | 87  | 124 | 130 | 6  | Sa        |            | Sp         | Sa type 1                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 87  | 130 | 149 | 19 | Sp        |            | Sa         | Perennial Turf Grass Type 2 | HighSp       |  |
| 7/24/2014 | Coast Guard | 87  | 149 | 151 | 2  | Sa        |            | Sp         | Sa type 1                   | LowSa        |  |
| 7/24/2014 | Coast Guard | 87  | 151 | 153 | 2  | Sa        |            |            | Sa type 1                   | LowSa        |  |
| 7/24/2014 | Coast Guard | 199 | 0   | 2   | 2  | Bare      |            |            | Mud flat/bare               | PanneBare    |  |
| 7/24/2014 | Coast Guard | 199 | 2   | 3   | 1  | Ds        |            | Sa         | Perennial Turf Grass Type 2 | HighDs       |  |
| 7/24/2014 | Coast Guard | 199 | 3   | 11  | 8  | Sp        |            | Sa Ds      | Perennial Turf Grass Type 2 | HighSp       |  |
| 7/24/2014 | Coast Guard | 199 | 11  | 14  | 4  | Sa        |            | Sp Ds      | Sa type 1                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 199 | 14  | 20  | 6  |           | Sa/Ds/Sali |            | Sa type 1                   | Transitional |  |
| 7/24/2014 | Coast Guard | 199 | 20  | 26  | 6  |           | Sa/Sp      |            | Sa type 1                   | Transitional |  |
| 7/24/2014 | Coast Guard | 199 | 26  | 26  | 1  | Bare      |            |            | Mud flat/bare               | PanneBare    |  |
| 7/24/2014 | Coast Guard | 199 | 26  | 27  | 1  | Sa        |            |            | Sa type 1                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 199 | 27  | 27  | 0  | Bare      |            |            | Mud flat/bare               | PanneBare    |  |
| 7/24/2014 | Coast Guard | 199 | 27  | 35  | 8  | Sa        |            |            | Sa type 1                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 199 | 35  | 36  | 2  | Sp        |            | Sa         | Perennial Turf Grass Type 2 | HighSp       |  |
| 7/24/2014 | Coast Guard | 199 | 36  | 40  | 4  | Sa        |            | Sali       | Sa type 2                   | MidSa        |  |
| 7/24/2014 | Coast Guard | 199 | 40  | 44  | 4  | Sp        |            | Sa         | Perennial Turf Grass Type 2 | HighSp       |  |

|           |             |     |     |     |    |      |       |                 |                             |              |                     |
|-----------|-------------|-----|-----|-----|----|------|-------|-----------------|-----------------------------|--------------|---------------------|
| 7/24/2014 | Coast Guard | 199 | 44  | 51  | 7  | Sa   |       | Sp Sali         | Sa type 1                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 199 | 51  | 53  | 3  | Sp   |       | Sali Sa         | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 199 | 53  | 55  | 2  | Sp   |       | Sali            | Sa type 2                   | HighSp       |                     |
| 7/24/2014 | Coast Guard | 199 | 55  | 68  | 13 | Sp   |       | Sa Sali         | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 199 | 68  | 73  | 5  | Sa   |       | Sali            | Sa type 2                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 199 | 73  | 78  | 5  | Sa   |       | Sp Sali         | Sa type 1                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 199 | 78  | 100 | 23 |      | Sa/Sp |                 | Sa type 1                   | Transitional |                     |
| 7/24/2014 | Coast Guard | 199 | 100 | 132 | 32 | Sa   |       | Sp              | Sa type 1                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 199 | 132 | 134 | 3  | Sp   |       | Sa              | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 199 | 134 | 138 | 4  | Sp   |       | Sa              | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 199 | 138 | 141 | 4  | Sa   |       | Sp              | Sa type 1                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 199 | 141 | 153 | 12 | Sp   |       | Sa              | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 199 | 153 | 157 | 4  | Sa   |       |                 | Sa type 1                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 311 | 0   | 2   | 2  | Ds   |       | Bare Phrag      | Invasives                   | HighDs       |                     |
| 7/24/2014 | Coast Guard | 311 | 2   | 7   | 5  | Sp   |       | Sa Sali         | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 311 | 7   | 8   | 1  | Bare |       | Sali Sa Sp      | Perennial Turf Grass Type 2 | Creek        | Creek               |
| 7/24/2014 | Coast Guard | 311 | 8   | 12  | 5  | Sa   |       | Sali S.Linearis | Sa type 1                   | MidSa        |                     |
| 7/24/2014 | Coast Guard | 311 | 12  | 14  | 2  | Sp   |       |                 | Perennial Turf Grass Type 1 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 311 | 14  | 16  | 2  | Sali |       | Sa              | Perennial Turf Grass Type 2 | PanneVeg     |                     |
| 7/24/2014 | Coast Guard | 311 | 16  | 20  | 4  | Sp   |       | Sa Sali         | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 311 | 20  | 25  | 6  | Sp   |       | Sa              | Perennial Turf Grass Type 2 | HighSp       |                     |
| 7/24/2014 | Coast Guard | 311 | 25  | 27  | 2  | Sa   |       | Sp              | Sa type 1                   | MidSa        | S. Linearis minimal |
| 7/24/2014 | Coast Guard | 311 | 27  | 30  | 3  | Sa   |       | Creek           | Ditch                       | MidSa        |                     |
| 7/24/2014 | Coast Guard | 311 | 30  | 61  | 31 | Sp   |       | Sa              | Perennial Turf Grass Type 2 | HighSp       |                     |

|           |             |     |     |     |    |         |       |              |                             |              |                 |
|-----------|-------------|-----|-----|-----|----|---------|-------|--------------|-----------------------------|--------------|-----------------|
| 7/24/2014 | Coast Guard | 311 | 61  | 62  | 2  | Sa      |       | Sp           | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 0   | 4   | 4  | Bulrush |       | Phrag, Typha | Invasives                   | Border       |                 |
| 8/12/2014 | Coast Guard | 87  | 4   | 10  | 7  | Bulrush |       | Typha Lat    | Invasives                   | Border       |                 |
| 8/12/2014 | Coast Guard | 87  | 10  | 13  | 3  | Bulrush |       | Phrag        | Invasives                   | Border       |                 |
| 8/12/2014 | Coast Guard | 87  | 13  | 18  | 5  | Bare    |       | Phrag Sa     | Invasives                   | PanneBare    |                 |
| 8/12/2014 | Coast Guard | 87  | 18  | 20  | 2  | Sa      |       | Sp           | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 20  | 22  | 3  | Sp      |       | Sa           | Perennial Turf Grass Type 2 | HighSp       |                 |
| 8/12/2014 | Coast Guard | 87  | 22  | 26  | 4  | Sa      |       |              | Sa type 1                   | Creek        | Creek           |
| 8/12/2014 | Coast Guard | 87  | 26  | 33  | 7  | Sp      |       |              | Perennial Turf Grass Type 1 | HighSp       |                 |
| 8/12/2014 | Coast Guard | 87  | 33  | 34  | 1  | Sa      |       |              | Sa type 1                   | MidSa        | Sulfur Bacteria |
| 8/12/2014 | Coast Guard | 87  | 34  | 35  | 1  | Sa      |       | Sp           | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 35  | 40  | 6  | Sa      |       | Sp Sali      | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 40  | 45  | 5  |         | Sa/Sp |              | Sa type 1                   | Transitional |                 |
| 8/12/2014 | Coast Guard | 87  | 45  | 48  | 3  | Sa      |       | Sp Sali      | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 48  | 54  | 7  | Sa      |       | Sp           | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 54  | 61  | 7  | Sa      |       | Sp Sali      | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 61  | 66  | 5  |         | Sa/Sp | Sali         | Sa type 1                   | Transitional |                 |
| 8/12/2014 | Coast Guard | 87  | 66  | 67  | 1  | Sp      |       | Sa Ds Sali   | Perennial Turf Grass Type 2 | HighSp       |                 |
| 8/12/2014 | Coast Guard | 87  | 67  | 77  | 10 |         | Sa/Sp | Sali Lim     | Sa type 1                   | Transitional |                 |
| 8/12/2014 | Coast Guard | 87  | 77  | 88  | 12 | Sa      |       | Sp Sali      | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 88  | 90  | 2  | Sp      |       | Sa           | Perennial Turf Grass Type 2 | HighSp       |                 |
| 8/12/2014 | Coast Guard | 87  | 90  | 94  | 5  | Sa      |       | Sali Ds LIM  | Sa type 1                   | MidSa        |                 |
| 8/12/2014 | Coast Guard | 87  | 94  | 113 | 19 | Sp      |       | Ds Sali      | Perennial Turf Grass Type 1 | HighSp       |                 |
| 8/12/2014 | Coast Guard | 87  | 113 | 115 | 2  | Sp      |       | Sa Sali Ds   | Perennial Turf Grass Type 2 | HighSp       |                 |

|           |             |     |     |     |   |       |       |                     |                             |              |  |
|-----------|-------------|-----|-----|-----|---|-------|-------|---------------------|-----------------------------|--------------|--|
| 8/12/2014 | Coast Guard | 87  | 115 | 116 | 1 | Sa    |       |                     |                             | SaCreek      |  |
| 8/12/2014 | Coast Guard | 87  | 116 | 122 | 6 | Creek |       |                     |                             | Creek        |  |
| 8/12/2014 | Coast Guard | 87  | 122 | 126 | 4 | Sa    |       |                     | Sa type 1                   | SaCreek      | Creek water 116-122 [split off to another entry] |
| 8/12/2014 | Coast Guard | 87  | 126 | 133 | 7 | Sa    |       | Sp                  | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 87  | 133 | 142 | 9 |       | Sa/Sp |                     | Sa type 1                   | Transitional |  |
| 8/12/2014 | Coast Guard | 87  | 142 | 149 | 7 | Sp    |       | Sa                  | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 87  | 149 | 153 | 4 |       | Sa/Sp |                     | Sa type 1                   | Transitional |  |
| 8/12/2014 | Coast Guard | 87  | 153 | 153 | 1 | Sa    |       | Sp Orach            | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 0   | 2   | 2 | Bare  |       |                     | Mud flat/bare               | PanneBare    |  |
| 8/12/2014 | Coast Guard | 199 | 2   | 10  | 8 | Sp    |       | Sali Sa Ds          | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 199 | 13  | 14  | 2 |       | Sa/Sp | Sali                | Sa type 1                   | Transitional |  |
| 8/12/2014 | Coast Guard | 199 | 14  | 22  | 8 | Sa    |       | Sali Sp             | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 22  | 30  | 8 | Sa    |       | Sali                | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 30  | 35  | 5 | Sa    |       | Sali Sp             | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 35  | 36  | 1 |       | Sa/Sp |                     | Sa type 1                   | Transitional |  |
| 8/12/2014 | Coast Guard | 199 | 36  | 40  | 4 | Sa    |       | Sali Sp             | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 40  | 43  | 4 | Sp    |       | Sa                  | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 199 | 43  | 52  | 9 | Sa    |       | Sali Sp             | Sa type 1                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 52  | 53  | 1 | Sp    |       | Sa                  | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 199 | 53  | 56  | 3 | Sp    |       | Sa Sali             | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 199 | 56  | 65  | 9 | Sp    |       | Sa                  | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 199 | 65  | 68  | 4 | Sp    |       | Sa Sali Marsh aster | Perennial Turf Grass Type 2 | HighSp       |  |
| 8/12/2014 | Coast Guard | 199 | 68  | 73  | 5 | Sa    |       | Sali                | Sa type 2                   | MidSa        |  |
| 8/12/2014 | Coast Guard | 199 | 73  | 78  | 5 | Sa    |       | Sali                | Sa type 2                   | MidSa        |  |

|           |             |     |     |     |    |      |         |                   |                             |              |                        |
|-----------|-------------|-----|-----|-----|----|------|---------|-------------------|-----------------------------|--------------|------------------------|
| 8/12/2014 | Coast Guard | 199 | 78  | 92  | 14 | Sp   |         | Sa                | Perennial Turf Grass Type 2 | HighSp       |                        |
| 8/12/2014 | Coast Guard | 199 | 91  | 99  | 8  |      | Sa/Sp   | Sp                | Sa type 1                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 199 | 99  | 108 | 9  | Sa   |         |                   | Sa type 1                   | MidSa        |                        |
| 8/12/2014 | Coast Guard | 199 | 108 | 113 | 6  |      | Sa/Sa   | Sp                | Sa type 1                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 199 | 131 | 135 | 4  |      | Sa/Sp   |                   | Sa type 1                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 199 | 135 | 141 | 7  | Sa   |         | Sp                | Sa type 1                   | MidSa        |                        |
| 8/12/2014 | Coast Guard | 199 | 141 | 153 | 12 | Sp   |         | Sa                | Perennial Turf Grass Type 2 | HighSp       |                        |
| 8/12/2014 | Coast Guard | 199 | 153 | 155 | 2  |      | Sa/Sp   |                   | Sa type 1                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 199 | 155 | 158 | 3  | Sa   |         |                   | Sa type 1                   | MidSa        |                        |
| 8/12/2014 | Coast Guard | 199 | 155 | 158 | 3  | Sa   |         |                   | Sa type 1                   | MidSa        |                        |
| 8/12/2014 | Coast Guard | 311 | 0   | 1   | 1  | Dead |         |                   | Mud flat/bare               | PanneBare    |                        |
| 8/12/2014 | Coast Guard | 311 | 1   | 2   | 2  | Ds   |         | Sp Phrag          | Invasives                   | HighDs       |                        |
| 8/12/2014 | Coast Guard | 311 | 2   | 6   | 4  | Sp   |         | Sa Ds             | Perennial Turf Grass Type 2 | HighSp       |                        |
| 8/12/2014 | Coast Guard | 311 | 6   | 13  | 7  | Sa   |         | Sali Bare         | Sa type 2                   | MidSa        |                        |
| 8/12/2014 | Coast Guard | 311 | 13  | 15  | 2  | Sp   |         | Sa                | Perennial Turf Grass Type 2 | HighSp       |                        |
| 8/12/2014 | Coast Guard | 311 | 15  | 16  | 2  |      | Sa/Sali |                   | Sa type 2                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 311 | 16  | 18  | 2  | Sp   |         | Ds Sa Sali        | Perennial Turf Grass Type 2 | HighSp       |                        |
| 8/12/2014 | Coast Guard | 311 | 18  | 20  | 2  | Sp   |         | Ds Sali Sa Sueda* | Perennial Turf Grass Type 2 | HighSp       | Sueda = purple flower? |
| 8/12/2014 | Coast Guard | 311 | 20  | 24  | 4  | Sp   |         | Sa                | Perennial Turf Grass Type 2 | HighSp       |                        |
| 8/12/2014 | Coast Guard | 311 | 24  | 25  | 2  |      | Sa/Sp   |                   | Sa type 1                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 311 | 25  | 27  | 2  | Sa   |         | Sp                | Sa type 1                   | MidSa        |                        |
| 8/12/2014 | Coast Guard | 311 | 27  | 30  | 3  | Sa   |         |                   | Sa type 1                   | Creek        | Creek                  |
| 8/12/2014 | Coast Guard | 311 | 30  | 31  | 1  |      | Sa/Sp   |                   | Sa type 1                   | Transitional |                        |
| 8/12/2014 | Coast Guard | 311 | 31  | 37  | 6  | Sp   |         | Sa                | Perennial Turf Grass Type 2 | HighSp       |                        |

|           |               |     |    |    |    |          |               |                 |                             |              |   |
|-----------|---------------|-----|----|----|----|----------|---------------|-----------------|-----------------------------|--------------|---|
| 8/12/2014 | Coast Guard   | 311 | 36 | 42 | 6  |          | Sa/Sp         |                 | Sa type 1                   | Transitional |   |
| 8/12/2014 | Coast Guard   | 311 | 42 | 45 | 3  | Sp       |               | Sa              | Perennial Turf Grass Type 2 | HighSp       |   |
| 8/12/2014 | Coast Guard   | 311 | 45 | 48 | 3  | Sa       |               | Sp              | Sa type 1                   | MidSa        |   |
| 8/12/2014 | Coast Guard   | 311 | 48 | 51 | 4  | Sp       |               | Sa              | Perennial Turf Grass Type 2 | HighSp       |   |
| 8/12/2014 | Coast Guard   | 311 | 51 | 61 | 10 |          | Sa/Sp         | Sali            | Sa type 1                   | Transitional |   |
| 8/12/2014 | Coast Guard   | 311 | 61 | 62 | 1  | Sa       |               | Sp              | Sa type 1                   | MidSa        |   |
| 7/9/2014  | Driftway      | 12  | 0  | 2  | 2  | SL       |               | Ds IVA Atriplex | Perennial Turf Grass Type 1 | Border       |   |
| 7/9/2014  | Driftway      | 12  | 2  | 3  | 1  |          | Bare/wrak     | Ds              | Mud flat/bare               | Border       | bare, rak, ds   |
| 7/9/2014  | Driftway      | 12  | 3  | 4  | 1  | Ds       |               | Sa Sp           | Perennial Turf Grass Type 2 | HighDs       |   |
| 7/9/2014  | Driftway      | 12  | 4  | 5  | 1  | Sp       |               | Sa Ds           | Perennial Turf Grass Type 2 | HighSp       |   |
| 7/9/2014  | Driftway      | 12  | 5  | 11 | 6  | Sp       |               | Sa              | Perennial Turf Grass Type 2 | HighSp       |   |
| 7/9/2014  | Driftway      | 12  | 11 | 16 | 6  |          | Sa/Sp         |                 | Sa type 1                   | Transitional | SP became codominant                                  |
| 7/9/2014  | Driftway      | 12  | 16 | 31 | 15 | Sa       |               | Sp              | Sa type 1                   | MidSa        |   |
| 7/9/2014  | Driftway      | 12  | 31 | 33 | 2  | Sa       |               | bare            | Mud flat/bare               | MidSa        |   |
| 7/9/2014  | Driftway      | 12  | 33 | 36 | 4  | Sa       |               | bare            | Mud flat/bare               | MidSa        |   |
| 7/9/2014  | Driftway      | 12  | 36 | 38 | 2  | Sa       |               | bare            | Mud flat/bare               | MidSa        |   |
| 7/9/2014  | Driftway      | 12  | 38 | 89 | 51 | Sa       |               |                 | Sa type 1                   | MidSa        | Pool adjacent to transect at 68 a lot more dead at 52 |
| 7/30/2014 | Driftway      | 12  | 0  | 4  | 4  | Ds       |               | Sa Sp           | Perennial Turf Grass Type 2 | HighDs       |   |
| 7/30/2014 | Driftway      | 12  | 4  | 9  | 5  |          | Sa Tall/Sp    |                 | Low marsh                   | Transitional |   |
| 7/30/2014 | Driftway      | 12  | 9  | 31 | 22 |          | Sa/Sp         |                 | Sa type 1                   | Transitional |   |
| 7/30/2014 | Driftway      | 12  | 31 | 32 | 1  |          | Sa/Sp/Bare    |                 | Sa type 1                   | Transitional | Muddy (Pannel) next to pool                           |
| 7/30/2014 | Driftway      | 12  | 32 | 50 | 18 |          | Sa/Sp         |                 | Sa type 1                   | Transitional |   |
| 7/30/2014 | Driftway      | 12  | 50 | 60 | 10 |          | Sa/Dead Stuff | Sp              | Sa type 1                   | MidSa        |   |
| 7/30/2014 | Driftway      | 12  | 60 | 88 | 28 | Sa       |               | Sp              | Sa type 1                   | MidSa        | Slightly More SA                                      |
| 7/1/2014  | Harbor Master | 25  | 0  | 2  | 2  | Sa tall  |               |                 | Low marsh                   | LowSa        | open mud 10%  |
| 7/1/2014  | Harbor Master | 25  | 2  | 10 | 8  | Sa short |               |                 | Sa type 1                   | MidSa        |   |
| 7/1/2014  | Harbor Master | 25  | 10 | 43 | 33 | Sp       |               | Sa              | Perennial Turf Grass Type 2 | HighSp       | a lot is dry/dead flattened                           |
| 7/1/2014  | Harbor Master | 25  | 42 | 48 | 6  | Phrag    |               | poison ivy Sa   | Invasives                   | Phrag        |   |
| 8/14/2014 | Harbor Master | 25  | 0  | 2  | 2  |          | Phrag/Sa/Ds   |                 | Invasives                   | HighCoD      |   |



|           |                     |    |    |    |    |          |       |                     |                               |           |                    |
|-----------|---------------------|----|----|----|----|----------|-------|---------------------|-------------------------------|-----------|--------------------|
| 8/14/2014 | Harbor Master       | 25 | 2  | 4  | 2  | Ds       |       |                     | Perennial Turf Grass Type 1   | HighDs    |                    |
| 8/14/2014 | Harbor Master       | 25 | 4  | 12 | 8  | Ds       |       |                     | Perennial Turf Grass Type 1   | HighDs    |                    |
| 8/14/2014 | Harbor Master       | 25 | 12 | 32 | 21 | Sp       |       | Ds JG               | Perennial Turf Grass Type 1   | HighSp    |                    |
| 8/14/2014 | Harbor Master       | 25 | 32 | 35 | 2  |          | Sp/JG | Ds dead             | Perennial Turf Grass Type 1   | HighCoD   |                    |
| 8/14/2014 | Harbor Master       | 25 | 35 | 35 | 1  | Sp       |       | Sali Ds             | Perennial Turf Grass Type 1   | HighSp    |                    |
| 8/14/2014 | Harbor Master       | 25 | 35 | 38 | 3  |          | Sp/Sa |                     | Perennial Turf Grass Type 2   | HighCoD   |                    |
| 8/14/2014 | Harbor Master       | 25 | 38 | 46 | 8  | Sa       |       |                     | Sa type 1                     | MidSa     |                    |
| 8/14/2014 | Harbor Master       | 25 | 46 | 47 | 1  | Bare Sa  |       |                     | Mud flat/bare                 | PanneBare |                    |
| 6/30/2014 | Jones River Landing | 23 | 0  | 1  | 1  | Sa short |       | Spikey leaf         | Sa type 1                     | LowSa     | JR-23E             |
| 6/30/2014 | Jones River Landing | 23 | 1  | 1  | 1  | Sp       |       |                     | Perennial Turf Grass Type 1   | HighSp    |                    |
| 6/30/2014 | Jones River Landing | 23 | 1  | 4  | 3  | Sa tall  |       |                     | Low marsh                     | LowSa     | paton + phrag wrak |
| 6/30/2014 | Jones River Landing | 23 | 4  | 12 | 9  | Sp       |       | Iva, Sp             | Perennial Turf Grass Type 1   | HighSp    |                    |
| 6/30/2014 | Jones River Landing | 23 | 12 | 19 | 7  | Sp       |       | Sa tall             | Perennial Turf Grass Type 2   | HighSp    |                    |
| 6/30/2014 | Jones River Landing | 23 | 19 | 33 | 14 | Sp       |       |                     | Perennial Turf Grass Type 1   | HighSp    |                    |
| 6/30/2014 | Jones River Landing | 23 | 33 | 34 | 2  | Sa short |       | M.plantain, JG, Iva | Sa type 1                     | MidSa     |                    |
| 6/30/2014 | Jones River Landing | 23 | 34 | 45 | 11 | Sa short |       | JG, Rushes          | Sa type 1                     | MidSa     |                    |
| 6/30/2014 | Jones River Landing | 23 | 45 | 51 | 6  | Bayberry |       | Phrag, Sp, FM       | Salt Marsh Terrestrial Border | Border    |                    |
| 6/30/2014 | Jones River Landing | 23 | 51 | 52 | 1  | Sa short |       | Sp                  | Sa type 1                     | MidSa     |                    |
| 6/30/2014 | Jones River Landing | 23 | 52 | 78 | 26 | Sp       |       | Phrag               | Invasives                     | HighSp    |                    |

|           |                     |     |    |    |    |          |          |                                 |                               |         |                    |
|-----------|---------------------|-----|----|----|----|----------|----------|---------------------------------|-------------------------------|---------|--------------------|
| 8/14/2014 | Jones River Landing | 23  | 0  | 4  | 4  | Sa       |          | unk. Spikey leaf                | Low marsh                     | LowSa   |                    |
| 8/14/2014 | Jones River Landing | 23  | 4  | 4  | 1  | Sa       |          | Sp                              | Sa type 1                     | MidSa   |                    |
| 8/14/2014 | Jones River Landing | 23  | 4  | 8  | 3  | Sa       |          | Sp JG                           | Sa type 1                     | MidSa   |                    |
| 8/14/2014 | Jones River Landing | 23  | 8  | 16 | 8  | Sp       |          | Sa JG                           | Sa type 1                     | HighSp  |                    |
| 8/14/2014 | Jones River Landing | 23  | 16 | 30 | 14 | Sp       |          | M. Plantain JG                  | Perennial Turf Grass Type 1   | HighSp  |                    |
| 8/14/2014 | Jones River Landing | 23  | 30 | 35 | 6  | Sp       |          | M.plantain Phrag                | Invasives                     | HighSp  |                    |
| 8/14/2014 | Jones River Landing | 23  | 35 | 40 | 5  | Sa       |          | unk. Spikey M.Plantain Sp Phrag | Invasives                     | MidSa   |                    |
| 8/14/2014 | Jones River Landing | 23  | 40 | 45 | 5  | Sa       |          | Sp                              | Sa type 1                     | MidSa   |                    |
| 8/14/2014 | Jones River Landing | 23  | 45 | 52 | 6  | Bayberry |          |                                 | Salt Marsh Terrestrial Border | Border  |                    |
| 8/14/2014 | Jones River Landing | 23  | 52 | 54 | 2  | Sa       |          | m. Plantain Sp Phrag            | Invasives                     | MidSa   |                    |
| 8/14/2014 | Jones River Landing | 23  | 54 | 61 | 7  | Sp       |          | JG                              | Perennial Turf Grass Type 1   | HighSp  |                    |
| 8/14/2014 | Jones River Landing | 23  | 61 | 78 | 17 | Sp       |          |                                 | Perennial Turf Grass Type 1   | HighSp  |                    |
| 7/1/2014  | L. Knife            | 227 | 0  | 1  | 1  | Sa Tall  |          |                                 | Low marsh                     | LowSa   | Some SA flowering  |
| 7/1/2014  | L. Knife            | 227 | 1  | 3  | 2  |          | Sp/Sa    |                                 | Perennial Turf Grass Type 2   | HighCoD |                    |
| 7/1/2014  | L. Knife            | 227 | 3  | 51 | 48 | Sp       |          | Sp                              | Perennial Turf Grass Type 1   | HighSp  | SA extremely short |
| 7/1/2014  | L. Knife            | 227 | 51 | 56 | 5  | Sa short |          | Sp                              | Sa type 1                     | MidSa   | SA extremely short |
| 7/1/2014  | L. Knife            | 227 | 56 | 58 | 2  | Sa       |          | Phrag                           | Invasives                     | MidSa   |                    |
| 8/14/2014 | L. Knife            | 227 | 0  | 1  | 1  |          | Sp/Ds/JG | Sa                              | Perennial Turf Grass Type 2   | HighCoD |                    |
| 8/14/2014 | L. Knife            | 227 | 1  | 7  | 6  |          | Sp/Sa/JG |                                 | Perennial Turf Grass Type 1   | HighCoD |                    |

|           |          |     |     |     |    |                |       |                  |                                |              |                   |
|-----------|----------|-----|-----|-----|----|----------------|-------|------------------|--------------------------------|--------------|-------------------|
| 8/14/2014 | L. Knife | 227 | 7   | 35  | 27 | Sp             |       | Ds JG            | Perennial Turf<br>Grass Type 1 | HighSp       |                   |
| 8/14/2014 | L. Knife | 227 | 35  | 37  | 3  | Sp             |       | Ds Sa            | Perennial Turf<br>Grass Type 1 | HighSp       | slightly hommocky |
| 8/14/2014 | L. Knife | 227 | 37  | 42  | 4  | Sp             |       | Ds               | Perennial Turf<br>Grass Type 1 | HighSp       |                   |
| 8/14/2014 | L. Knife | 227 | 42  | 45  | 4  | Sp             |       | Ds JG<br>Phrag   | Perennial Turf<br>Grass Type 1 | HighSp       |                   |
| 8/14/2014 | L. Knife | 227 | 45  | 47  | 2  | Ds             |       | Sali JG          | Perennial Turf<br>Grass Type 1 | HighDs       |                   |
| 8/14/2014 | L. Knife | 227 | 47  | 49  | 2  | Ds<br>bare     |       |                  | Perennial Turf<br>Grass Type 1 | HighDs       |                   |
| 7/24/2014 | Rexhame  | 55  | 0   | 7   | 7  | wrak/b<br>are  |       |                  | Mud flat/bare                  | Border       |                   |
| 7/24/2014 | Rexhame  | 55  | 7   | 8   | 2  | Sa             |       | Sp wrak          | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 8   | 11  | 3  | Sa             |       | Sp               | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 11  | 16  | 5  | Sa             |       | Ds Sali          | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 16  | 17  | 1  | Sali           |       | Sa               | Perennial Turf<br>Grass Type 2 | PanneVeg     |                   |
| 7/24/2014 | Rexhame  | 55  | 17  | 20  | 3  | Sa             |       | Sali             | Sa type 2                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 20  | 21  | 2  | Sa             |       | Ds Sali          | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 21  | 25  | 4  | Phrag          |       | Ds Sp Sa<br>Sali | Invasives                      | Phrag        |                   |
| 7/24/2014 | Rexhame  | 55  | 25  | 26  | 2  | Creek          |       |                  | Ditch                          | Creek        |                   |
| 7/24/2014 | Rexhame  | 55  | 26  | 28  | 2  | Sp             |       | Sa               | Perennial Turf<br>Grass Type 2 | HighSp       |                   |
| 7/24/2014 | Rexhame  | 55  | 28  | 34  | 6  | Ds             |       | Sp Sa Sali       | Perennial Turf<br>Grass Type 2 | HighDs       |                   |
| 7/24/2014 | Rexhame  | 55  | 34  | 39  | 5  | Sa             |       | Ds Sp Sali       | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 39  | 47  | 8  | Sa             |       | Sali Sp          | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 47  | 55  | 8  | Sa             |       | Sa;              | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 55  | 57  | 2  | Sa             |       | bare Sali        | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 57  | 59  | 2  | Sa             |       |                  | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 59  | 61  | 1  | bare/p<br>anne |       |                  | Panne                          | PanneBare    |                   |
| 7/24/2014 | Rexhame  | 55  | 61  | 62  | 1  | Sa             |       | Sali bare        | Sa type 2                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 62  | 63  | 1  | bare           |       | Sa Sali          | Mud flat/bare                  | PanneBare    |                   |
| 7/24/2014 | Rexhame  | 55  | 63  | 64  | 1  | Sa             |       |                  | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 64  | 90  | 26 | Sa             |       | Sali             | Sa type 2                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 90  | 91  | 1  | Sa             |       | Sali             | Sa type 2                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 91  | 92  | 1  | Sa             |       |                  | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 92  | 105 | 13 |                | Sa/Sp | Sali             | Sa type 1                      | Transitional |                   |
| 7/24/2014 | Rexhame  | 55  | 105 | 106 | 1  | Sa             |       | Sp               | Sa type 1                      | MidSa        |                   |
| 7/24/2014 | Rexhame  | 55  | 106 | 110 | 5  | pool           |       |                  | Pool                           | Pool         |                   |

|           |         |     |     |     |    |                   |       |               |                                |              |  |
|-----------|---------|-----|-----|-----|----|-------------------|-------|---------------|--------------------------------|--------------|--|
| 7/24/2014 | Rexhame | 55  | 110 | 112 | 2  | Sa                |       | Sp            | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 55  | 112 | 115 | 3  | Sp                |       | Ds Sa Sali    | Perennial Turf<br>Grass Type 2 | HighSp       |  |
| 7/24/2014 | Rexhame | 55  | 115 | 122 | 7  |                   | Sp/Ds |               | Perennial Turf<br>Grass Type1  | HighCoD      |  |
| 7/24/2014 | Rexhame | 55  | 122 | 125 | 3  | Sp                |       | Sa Sali       | Perennial Turf<br>Grass Type 2 | HighSp       |  |
| 7/24/2014 | Rexhame | 55  | 125 | 129 | 4  |                   | Sa/Sp | Sa Sp         | Sa type 1                      | Transitional |  |
| 7/24/2014 | Rexhame | 55  | 129 | 132 | 4  | Sa                |       | Sa            | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 0   | 2   | 2  | Wrak              |       | Phrag         | Invasives                      | Border       |  |
| 7/24/2014 | Rexhame | 170 | 2   | 4   | 2  | Sp                |       | Sa Rack<br>Ds | Perennial Turf<br>Grass Type 2 | HighSp       |  |
| 7/24/2014 | Rexhame | 170 | 4   | 9   | 5  | Sa                |       | Sali          | Sa type 2                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 9   | 14  | 5  | Sali<br>PANN<br>E |       | Sa            | Panne                          | PanneVeg     |  |
| 7/24/2014 | Rexhame | 170 | 14  | 21  | 7  | Sa                |       | Sali          | Sa type 2                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 21  | 22  | 1  | Creek             |       |               | Ditch                          | Creek        |  |
| 7/24/2014 | Rexhame | 170 | 22  | 27  | 5  | Sa                |       | Sp Ds         | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 27  | 61  | 34 |                   | Sp/Ds | Sa            | Perennial Turf<br>Grass Type 2 | HighCoD      |  |
| 7/24/2014 | Rexhame | 170 | 61  | 64  | 3  |                   | Sa/Sp | Ds            | Sa type 1                      | Transitional |  |
| 7/24/2014 | Rexhame | 170 | 64  | 74  | 11 | Sp                |       | Ds            | Perennial Turf<br>Grass Type 1 | HighSp       |  |
| 7/24/2014 | Rexhame | 170 | 74  | 81  | 7  |                   | Sa/Sp | Ds            | Sa type 1                      | Transitional |  |
| 7/24/2014 | Rexhame | 170 | 81  | 86  | 5  |                   | Sp/Ds | Sa            | Perennial Turf<br>Grass Type 2 | HighCoD      |  |
| 7/24/2014 | Rexhame | 170 | 86  | 91  | 5  |                   | Sp/Ds |               | Sa type 1                      | HighCoD      |  |
| 7/24/2014 | Rexhame | 170 | 91  | 94  | 3  | Sp                |       | Sa Ds         | Perennial Turf<br>Grass Type 2 | HighSp       |  |
| 7/24/2014 | Rexhame | 170 | 94  | 95  | 1  | Sa                |       |               | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 95  | 97  | 3  | Sa                |       | Sp            | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 97  | 105 | 8  | Sp                |       | Sali Sa Ds    | Perennial Turf<br>Grass Type 2 | HighSp       |  |
| 7/24/2014 | Rexhame | 170 | 105 | 111 | 6  |                   | Sa/Sp | Ds            | Sa type 1                      | Transitional |  |
| 7/24/2014 | Rexhame | 170 | 111 | 121 | 10 |                   | Sp/Ds | Sa            | Perennial Turf<br>Grass Type 2 | HighCoD      |  |
| 7/24/2014 | Rexhame | 170 | 121 | 131 | 11 | Sa                |       | Sp Ds         | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 131 | 132 | 1  | Sa                |       |               | Sa type 1                      | MidSa        |  |
| 7/24/2014 | Rexhame | 170 | 132 | 139 | 7  | Sp                |       | Sa Sali       | Perennial Turf<br>Grass Type 2 | HighSp       |  |
| 7/24/2014 | Rexhame | 170 | 139 | 140 | 2  | Sa                |       |               | Sa type 1                      | MidSa        |  |
| 8/12/2014 | Rexhame | 55  | 0   | 2   | 2  | Ds                |       | Sp JG         | Perennial Turf<br>Grass Type 1 | HighDs       |  |

|           |         |     |     |     |    |               |       |                         |                                |              |       |
|-----------|---------|-----|-----|-----|----|---------------|-------|-------------------------|--------------------------------|--------------|-------|
| 8/12/2014 | Rexhame | 55  | 2   | 7   | 6  | Dead/<br>bare |       |                         | Mud flat/bare                  | PanneBare    |       |
| 8/12/2014 | Rexhame | 55  | 7   | 9   | 2  |               | Sp/Sa |                         | Sa type 1                      | HighCoD      |       |
| 8/12/2014 | Rexhame | 55  | 9   | 11  | 2  | Sa            |       | Sp                      | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 11  | 16  | 6  | Sa            |       | Ds Sali                 | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 16  | 18  | 2  | Sali          |       | Bare Sa                 | Sa type 2                      | PanneVeg     |       |
| 8/12/2014 | Rexhame | 55  | 18  | 21  | 3  | Sa            |       | Ds Sali                 | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 21  | 22  | 2  | Sp            |       | Ds Phrag<br>Sa Sali     | Perennial Turf<br>Grass Type 2 | HighSp       |       |
| 8/12/2014 | Rexhame | 55  | 22  | 24  | 2  | Phrag         |       | Sp Sa Ds<br>Sali        | Invasives                      | Phrag        |       |
| 8/12/2014 | Rexhame | 55  | 24  | 26  | 2  | Creek         |       |                         | Creek                          | Creek        |       |
| 8/12/2014 | Rexhame | 55  | 26  | 27  | 1  | Sa            |       |                         | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 27  | 29  | 3  |               | Sp/Sa | Ds                      | Perennial Turf<br>Grass Type 2 | HighCoD      |       |
| 8/12/2014 | Rexhame | 55  | 29  | 35  | 6  |               | Sp/Ds | Lim Sa<br>Sali          | Perennial Turf<br>Grass Type 2 | HighCoD      |       |
| 8/12/2014 | Rexhame | 55  | 35  | 42  | 8  | Sa            |       | Sp Ds Sali              | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 42  | 60  | 18 | Sa            |       | Sali Sp                 | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 60  | 65  | 5  | Bare          |       | Sa Sali                 | Mud flat/bare                  | PanneBare    |       |
| 8/12/2014 | Rexhame | 55  | 65  | 68  | 4  | Sa            |       | Bare Sali               | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 68  | 76  | 8  | Sa            |       | Sp Lim Sal              | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 76  | 93  | 17 | Sa            |       | Lim<br>Plantain<br>Sali | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 93  | 109 | 16 | Sp            |       | Sa Ds                   | Perennial Turf<br>Grass Type 2 | HighSp       |       |
| 8/12/2014 | Rexhame | 55  | 109 | 113 | 4  | Pool          |       |                         | Open Water                     | Pool         |       |
| 8/12/2014 | Rexhame | 55  | 113 | 117 | 4  |               | Sp/Sa | Ds                      | Perennial Turf<br>Grass Type 2 | HighCoD      |       |
| 8/12/2014 | Rexhame | 55  | 117 | 124 | 7  |               | Ds/Sp | Sa Sali                 | Perennial Turf<br>Grass Type 2 | HighCoD      |       |
| 8/12/2014 | Rexhame | 55  | 124 | 128 | 5  | Sa            |       | Sp Ds Sali              | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 55  | 128 | 130 | 2  |               | Sa/Sp | Ds                      | Sa type 1                      | Transitional |       |
| 8/12/2014 | Rexhame | 55  | 130 | 135 | 5  | Sa            |       | Sp Ds                   | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 170 | 0   | 2   | 2  | Dead/<br>bare |       | Phrag                   | Mud flat/bare                  | PanneBare    |       |
| 8/12/2014 | Rexhame | 170 | 2   | 4   | 2  | Sa            |       | Sp Bare                 | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 170 | 4   | 5   | 1  |               | Sa/Sp | Sali                    | Sa type 1                      | Transitional |       |
| 8/12/2014 | Rexhame | 170 | 5   | 8   | 3  | Sa            |       | Sali                    | Sa type 2                      | MidSa        |       |
| 8/12/2014 | Rexhame | 170 | 8   | 9   | 1  | Sa            |       | Ds Sali                 | Sa type 1                      | MidSa        |       |
| 8/12/2014 | Rexhame | 170 | 9   | 11  | 3  | Sali          |       | Sa                      | Perennial Turf<br>Grass Type 2 | PanneVeg     |       |
| 8/12/2014 | Rexhame | 170 | 11  | 14  | 3  | Bare          |       | Sali                    | Mud flat/bare                  | PanneBare    | panne |

|           |                              |     |     |     |    |       |       |                  |                                |              |                     |
|-----------|------------------------------|-----|-----|-----|----|-------|-------|------------------|--------------------------------|--------------|---------------------|
| 8/12/2014 | Rexhame                      | 170 | 14  | 19  | 6  | Sali  |       | Sa               | Perennial Turf<br>Grass Type 2 | PanneVeg     |                     |
| 8/12/2014 | Rexhame                      | 170 | 19  | 20  | 1  | Sa    |       |                  | Sa type 1                      | MidSa        |                     |
| 8/12/2014 | Rexhame                      | 170 | 20  | 21  | 1  | Creek |       |                  | Ditch                          | Creek        |                     |
| 8/12/2014 | Rexhame                      | 170 | 21  | 23  | 2  | Sa    |       | Sp               | Sa type 1                      | MidSa        |                     |
| 8/12/2014 | Rexhame                      | 170 | 23  | 39  | 17 |       | Sa/Sp | Sa Ds Sali       | Sa type 1                      | Transitional |                     |
| 8/12/2014 | Rexhame                      | 170 | 39  | 48  | 9  | Sp    |       | Sp Sa            | Perennial Turf<br>Grass Type 2 | HighSp       |                     |
| 8/12/2014 | Rexhame                      | 170 | 48  | 56  | 8  | Ds    |       | Sp Sa            | Perennial Turf<br>Grass Type 2 | HighDs       |                     |
| 8/12/2014 | Rexhame                      | 170 | 56  | 73  | 17 | Sp    |       | Sa Ds Sali       | Perennial Turf<br>Grass Type 2 | HighSp       |                     |
| 8/12/2014 | Rexhame                      | 170 | 73  | 83  | 11 |       | Sa/Sp | Ds               | Sa type 1                      | Transitional |                     |
| 8/12/2014 | Rexhame                      | 170 | 83  | 91  | 8  | Sp    |       | Ds Sa            | Perennial Turf<br>Grass Type 2 | HighSp       |                     |
| 8/12/2014 | Rexhame                      | 170 | 91  | 115 | 24 |       | Sa/Sp | Sali             | Sa type 1                      | Transitional |                     |
| 8/12/2014 | Rexhame                      | 170 | 115 | 117 | 2  |       | Sp/Ds | Sa               | Perennial Turf<br>Grass Type 2 | HighCoD      |                     |
| 8/12/2014 | Rexhame                      | 170 | 117 | 126 | 9  | Ds    |       | Sp Sa            | Perennial Turf<br>Grass Type 2 | HighDs       |                     |
| 8/12/2014 | Rexhame                      | 170 | 126 | 127 | 1  | Sa    |       | Ds Sp            | Sa type 1                      | MidSa        |                     |
| 8/12/2014 | Rexhame                      | 170 | 127 | 135 | 8  | Sa    |       | Sp               | Sa type 1                      | MidSa        |                     |
| 8/12/2014 | Rexhame                      | 170 | 135 | 143 | 8  | Sa    |       | Sp Sali<br>Orach | Sa type 1                      | MidSa        |                     |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 0   | 2   | 2  | Bare  |       |                  | Mud flat/bare                  | PanneBare    | bare                |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 2   | 13  | 11 | Sa    |       |                  | Sa type 1                      | LowSa        |                     |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 13  | 17  | 5  | Sa    |       | Sp Bare          | Sa type 1                      | MidSa        | more bare than last |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 17  | 25  | 8  | Sa    |       |                  | Sa type 1                      | MidSa        | little bit sp       |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 25  | 29  | 5  | Sp    |       | Sa bare          | Perennial Turf<br>Grass Type 2 | HighSp       |                     |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 29  | 41  | 12 | Sa    |       | Sp               | Sa type 1                      | MidSa        |                     |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 41  | 45  | 4  | Sa    |       | Sp bare          | Sa type 1                      | MidSa        |                     |

|           |                              |     |    |    |    |             |  |                |                                |           |                                 |
|-----------|------------------------------|-----|----|----|----|-------------|--|----------------|--------------------------------|-----------|---------------------------------|
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 45 | 58 | 13 | Sp          |  | bare           | Mud flat/bare                  | HighSp    | bare                            |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 58 | 60 | 3  | Sp          |  | Sa Sali        | Perennial Turf<br>Grass Type 2 | HighSp    |                                 |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 60 | 65 | 5  | Sp          |  | Sa Sali        | Perennial Turf<br>Grass Type 2 | HighSp    | diff/higher density             |
| 7/2/2014  | Scituate<br>Conservat<br>ion | 120 | 65 | 67 | 3  | Sa          |  | Sp             | Sa type 1                      | MidSa     | purple sulfur bacteria          |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 0  | 1  | 1  | Sa          |  |                | Sa type 1                      | LowSa     | bearing not working             |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 1  | 4  | 3  | Sa<br>Bare  |  |                | Mud flat/bare                  | PanneBare |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 4  | 16 | 12 | Sa          |  | bare<br>(Same) | Mud flat/bare                  | MidSa     | kind of hummocky                |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 16 | 20 | 4  | Sp          |  | Sa             | Perennial Turf<br>Grass Type 2 | HighSp    |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 20 | 26 | 6  | Sa          |  | Sp             | Sa type 1                      | MidSa     | some SA flowering               |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 26 | 31 | 4  | Sp          |  | Sa             | Perennial Turf<br>Grass Type 2 | HighSp    |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 31 | 41 | 10 | Sa          |  | Sp bare        | Sa type 1                      | MidSa     |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 41 | 47 | 6  | Sp          |  |                | Perennial Turf<br>Grass Type 1 | HighSp    |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 47 | 48 | 1  | Bare        |  | Sali Sp        | Mud flat/bare                  | PanneBare |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 48 | 57 | 9  | Sp          |  | Sali           | Sa type 2                      | HighSp    |                                 |
| 7/30/2014 | Scituate<br>Conservat<br>ion | 120 | 57 | 61 | 4  | Sa          |  | Sp             | Sa type 1                      | MidSa     |                                 |
| 7/2/2014  | Trouants<br>Island           | 96  | 0  | 3  | 3  | Sa<br>short |  |                | Sa type 1                      | LowSa     | holes hommocky                  |
| 7/2/2014  | Trouants<br>Island           | 96  | 3  | 10 | 7  | Sa          |  | Sp             | Sa type 1                      | MidSa     | holes in ground still- hommocky |



|           |                 |    |    |    |    |         |          |             |                             |         |                      |
|-----------|-----------------|----|----|----|----|---------|----------|-------------|-----------------------------|---------|----------------------|
| 7/2/2014  | Trouants Island | 96 | 10 | 23 | 14 | Sp      |          | Sa          | Perennial Turf Grass Type 2 | HighSp  |                      |
| 7/2/2014  | Trouants Island | 96 | 23 | 26 | 3  | Sp      |          |             | Perennial Turf Grass Type 1 | HighSp  |                      |
| 7/2/2014  | Trouants Island | 96 | 26 | 32 | 6  | Sp      |          | JG          | Perennial Turf Grass Type 1 | HighSp  |                      |
| 7/2/2014  | Trouants Island | 96 | 32 | 36 | 4  | AB      |          | JG Plantain | Perennial Turf Grass Type 1 | Border  |                      |
| 7/31/2014 | Trouants Island | 96 | 0  | 2  | 2  | Sa tall |          |             | Low marsh                   | LowSa   |                      |
| 7/31/2014 | Trouants Island | 96 | 2  | 5  | 3  | Sp      |          | Sa Plantain | Perennial Turf Grass Type 1 | HighSp  |                      |
| 7/31/2014 | Trouants Island | 96 | 5  | 12 | 6  | Sp      |          | JG          | Perennial Turf Grass Type 1 | HighSp  |                      |
| 7/31/2014 | Trouants Island | 96 | 12 | 22 | 10 | Sp      |          | Sa JG       | Perennial Turf Grass Type 1 | HighSp  | hummocks treacherous |
| 7/31/2014 | Trouants Island | 96 | 22 | 25 | 4  |         | Sp/Sa/JG |             | Perennial Turf Grass Type 1 | HighCoD | more open hummocks   |
| 7/31/2014 | Trouants Island | 96 | 25 | 29 | 3  |         | Sp/Sa/JG | more bare   | Perennial Turf Grass Type 1 | HighCoD |                      |
| 7/31/2014 | Trouants Island | 96 | 29 | 32 | 4  | Sa      |          | Sp          | Sa type 1                   | MidSa   |                      |

**Table 2. Bearing Capacity Data**

| Marsh ID          | Date      | Transect ID | Distance Along Transect (m) | Initial Capacity (cm) | Blow 1 (cm) | Blow 2 (cm) | Blow 3 (cm) | Blow 4 (cm) | Blow 5 (cm) | Habitat Type |
|-------------------|-----------|-------------|-----------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|--------------|
| <b>JRWA</b>       |           |             |                             |                       |             |             |             |             |             |              |
| Harbor Master     | 7/1/2014  | HM 25E      | .3 m                        | 0                     | 2           | 3           | 4           | 4           | 5           | SA tall      |
| Harbor Master     | 7/1/2014  | HM 25E      | 4 m                         | 0                     | 1           | 2           | 3           | 3           | 4           | SA short     |
| Harbor Master     | 7/1/2014  | HM 25E      | 70 m                        | 0                     | 2           | 2.5         | 3           | 3           | 3           | SP           |
| Harbor Master     | 8/15/2014 | HM 25E      | 3.8                         | 0                     | 3           | 5           | 6           | 7.5         | 8           | DS SP        |
| Harbor Master     | 8/15/2014 | HM 25E      | 16.2                        | 0                     | 3           | 4           | 5           | 6           | 6.5         | SP DS JG     |
| Harbor Master     | 8/15/2014 | HM 25E      | 45.2                        | 0                     | 5.5         | 8           | 10          | 13          | 15          | SA Bare      |
| Callista          | 7/1/2014  | CP72        | 14.5                        | 0                     | 3           | 4           | 5           | 5.5         | 5.5         | SP           |
| Callista          | 7/1/2014  | CP72        | 19.5                        | 0                     | 4           | 5           | 6           | 6           | 8           | SP dead      |
| Callista          | 7/1/2014  | CP72        | 3                           | 0                     | 3           | 4.5         | 5.5         | 6           | 6.5         | SP/SA        |
| Callista          | 7/1/2014  | CP72        | 1                           | 0                     | 3.5         | 5           | 5.5         | 6           | 7           | SA           |
| Callista          | 8/15/2014 | CP72        | 55.5                        | 0                     | 2           | 3           | 3           | 3           | 3           | SP DS        |
| Callista          | 8/15/2014 | CP72        | 30.9                        | 0                     | 2           | 3           | 3.5         | 3.5         | 4           | dead         |
| Callista          | 8/15/2014 | CP72        | 4.7                         | 0                     | 4           | 6           | 6           | 8           | 9           | SA SP        |
| JonesRiverLanding | 6/30/2014 | JR-23       | 16.1                        | 0                     | 0.75        | 1.5         | 1.5         | 1.5         | 1.5         | SP           |
| JonesRiverLanding | 6/30/2014 | JR-23       | 2.7                         | 0                     | 2.25        | 3.5         | 5           | 6           | 6           | transitional |
| JonesRiverLanding | 6/30/2014 | JR-23       | 0.5                         | 0                     | 1.25        | 2           | 3.5         | 3.5         | 4.25        | Low Marsh SA |
| JonesRiverLanding | 8/14/2014 | JR-23       | 30.2                        | 0                     | 1           | 1           | 1.5         | 2           | 2.5         | SP           |
| JonesRiverLanding | 8/14/2014 | JR-23       | 3.5                         | 0                     | 2           | 3           | 3           | 4           | 5           | SA           |
| L. Knife          | 7/1/2014  | LK 227      | 2 m                         | 0                     | 3           | 4           | 4.5         | 5           | 5           | SP SA        |
| L. Knife          | 7/1/2014  | LK 227      | 40 m                        | 0                     | 1           | 2           | 2.5         | 2.5         | 2.5         | SP           |
| L. Knife          | 8/14/2014 | LK 227      | 47.6                        | 0                     | 4           | 5           | 6           | 6           | 6           | DS bare      |
| <b>NSRWA</b>      |           |             |                             |                       |             |             |             |             |             |              |
| CoastGuard        | 7/24/2014 | CG 199      | 18.7                        | 0.5                   | 2           | 3           | 3           | 4           | 4           | SA           |
| CoastGuard        | 7/24/2014 | CG 199      | 32                          | 3                     | 5.5         | 7           | 7.5         | 8           | 8           | SA SP        |
| CoastGuard        | 7/24/2014 | CG 199      | 51.5                        | 0                     | 2           | 2           | 2           | 2           | 2           | SP SA        |
| CoastGuard        | 7/24/2014 | CG 199      | 108.5                       | 0                     | 1           | 2           | 2           | 2           | 2           | SP           |
| CoastGuard        | 7/24/2014 | CG 199      | 117                         | 0                     | 2           | 2.5         | 3           | 4           | 4           | SA           |

| Marsh ID   | Date      | Transect ID | Distance Along Transect (m) | Initial Capacity (cm) | Blow 1 (cm) | Blow 2 (cm) | Blow 3 (cm) | Blow 4 (cm) | Blow 5 (cm) | Habitat Type |
|------------|-----------|-------------|-----------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|--------------|
| CoastGuard | 7/24/2014 | CG 311      | 8.65                        | 0                     | 1           | 1           | 1.5         | 1.75        | 2           | SA SP        |
| CoastGuard | 7/24/2014 | CG 311      | 38                          | 1                     | 3           | 3.5         | 4           | 4           | 4.5         | SA SP        |
| CoastGuard | 7/24/2014 | CG 311      | 60.7                        | 3                     | 4           | 5           | 5.5         | 5.5         | 6           | SA           |
| CoastGuard | 8/12/2014 | CG 311      | 22                          | 1                     | 2           | 2           | 3           | 3.5         | 3.5         | SA           |
| CoastGuard | 8/12/2014 | CG 311      | 30.8                        | 0                     | 1.5         | 2           | 5           | 3.5         | 4           | SP           |
| CoastGuard | 8/12/2014 | CG 311      | 107                         | 0.5                   | 2           | 3           | 4           | 5           | 5           | SP JG        |
| CoastGuard | 8/12/2014 | CG 311      | 139                         | 0                     | 3.5         | 4           | 5           | 5           | 5           | SA SP        |
| CoastGuard | 8/12/2014 | CG 311      | 152                         | 0                     | 1           | 2           | 3.5         | 4           | 4.5         | SA SP        |
| CoastGuard | 8/12/2014 | CG 87       | 9.5                         | 0                     | 1           | 1.5         | 1.5         | 1.5         | 2           | Bare SA      |
| CoastGuard | 8/12/2014 | CG 87       | 37.5                        | 0                     | 2           | 3           | 3           | 3           | 3.5         | SA SP        |
| CoastGuard | 8/12/2014 | CG 87       | 60.5                        | 0                     | 2           | 2.5         | 3           | 3.5         | 4           | SP SA Tall   |
| CoastGuard | 8/12/2014 | CG 199      | 7                           | 0                     | 1.5         | 2           | 2.5         | 3           | 3           | SP           |
| CoastGuard | 8/12/2014 | CG 199      | 29                          | 0                     | 2           | 2           | 2           | 2.5         | 2.5         | SA Short     |
| CoastGuard | 8/12/2014 | CG 199      | 120                         | 0                     | 1           | 2           | 3           | 4           | 4           | SA           |
| CoastGuard | 8/12/2014 | CG 199      | 157                         | 0                     | 1.5         | 2           | 3           | 4.5         | 5           | SA           |
| CoastGuard | 7/29/2014 | CG 87       | 6                           | 0                     | 3           | 3           | 4.5         | 5           | 5           | SP SA        |
| CoastGuard | 7/29/2014 | CG 87       | 20.5                        | 0                     | 1           | 1           | 2           | 2.5         | 3           | SA shert     |
| CoastGuard | 7/29/2014 | CG 87       | 77                          | 1                     | 2.5         | 2.5         | 5           | 5.5         | 6           | SA SP        |
| CoastGuard | 7/29/2014 | CG 87       | 90.8                        | 0.5                   | 4           | 4           | 6           | 6           | 6.5         | SP           |
| CoastGuard | 7/29/2014 | CG 87       | 155                         | 0                     | 2           | 2           | 3           | 3           | 3           | SA           |
| CoastGuard | 7/29/2014 | CG 87       | 143.8                       | 0                     | 2           | 2           | 3           | 3           | 3           | SP SA        |
| Driftway   | 7/9/2014  | DW12        | 7 m                         | 0                     | 1.5         | 2           | 2           | 3           | 3.25        | SP W/ SA     |
| Driftway   | 7/9/2014  | DW12        | 52 m                        | 0                     | 4           | 4           | 5           | 6           | 6           | SA           |
| Driftway   | 7/9/2014  | DW12        | 82 m                        | 3                     | 5           | 6           | 7           | 8           | 8.5         | SA           |
| Driftway   | 7/30/2014 | DW 12       | 5.8                         | 0                     | 2           | 2.5         | 3.5         | 3.5         | 4           | SA Tall SP   |
| Driftway   | 7/30/2014 | DW 12       | 31.4                        | 3                     | 6           | 8           | 9           | 10.5        | 11          | Muddy SA/SP  |
| Driftway   | 7/30/2014 | DW 12       |                             | 0                     | 1.5         | 2           | 2.5         | 2.5         | 3           | SA SP        |
| Driftway   | 7/30/2014 | DW 12       | 57.2                        | 0                     | 2.5         | 3.5         | 4.5         | 5.5         | 6           | SA SP end    |
| Rexhame    | 7/31/2014 | RX 170      | 12                          | 1                     | 3           | 4.5         | 5           | 5           | 6           | Panne SAL SA |
| Rexhame    | 7/31/2014 | RX 170      | 44.5                        | 0                     | 1           | 3           | 3           | 3           | 3           | SP           |

| Marsh ID             | Date      | Transect ID | Distance Along Transect (m) | Initial Capacity (cm) | Blow 1 (cm) | Blow 2 (cm) | Blow 3 (cm) | Blow 4 (cm) | Blow 5 (cm) | Habitat Type |
|----------------------|-----------|-------------|-----------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|--------------|
| Rexhame              | 7/31/2014 | RX 170      | 100                         | 0                     | 1.5         | 2.5         | 3           | 4           | 4.5         | SP SA SAL    |
| Rexhame              | 8/12/2014 | RX 170      | 12                          | 0                     | 4           | 5           | 5.5         | 6           | 6           | Panne        |
| Rexhame              | 8/12/2014 | RX 170      | 85                          | 0.5                   | 2.5         | 4           | 4.5         | 5.5         | 5.5         | SP           |
| Rexhame              | 8/12/2014 | RX 170      | 110                         | 0                     | 1           | 1           | 1.5         | 2           | 2.5         | SP SA        |
| Rexhame              | 8/12/2014 | RX 170      | 141.5                       | 0                     | 1.5         | 2           | 3           | 3.5         | 4           | SA SP        |
| Rexhame              | 7/24/2014 | RX 55       | 132                         | 0                     | 1           | 1           | 2           | 2           | 2           | DS           |
| Rexhame              | 7/24/2014 | RX 55       |                             | 0                     | 2           | 2           | 3.5         | 4           | 5           | SA           |
| Rexhame              | 7/24/2014 | RX 55       | 33.5                        | 0.1                   | 2.5         | 2.5         | 3.5         | 4           | 4.5         | Panne        |
| Rexhame              | 7/24/2014 | RX 55       | 12                          | 0.5                   | 2           | 2           | 3           | 3.5         | 3.5         | SA short     |
| Rexhame              | 8/12/2014 | RX 55       | 12                          | 0                     | 2           | 3           | 3           | 3           | 3           | SA           |
| Rexhame              | 8/12/2014 | RX 55       | 32                          | 0.5                   | 2           | 2           | 3           | 4           | 4.5         | SA SAL SP DS |
| Rexhame              | 8/12/2014 | RX 55       | 62                          | 0.5                   | 2.5         | 2.5         | 3           | 3           | 3.5         | Panne SAL DS |
| Rexhame              | 8/12/2014 | RX 55       | 122                         | 0                     | 1           | 1.5         | 2           | 2           | 2           | SP           |
| Rexhame              | 8/12/2014 | RX 55       | 133.5                       | 0                     | 2           | 3           | 3           | 4           | 4           | SA edge      |
| ScituateConservation | 7/2/2014  | SC 120      | 116                         | 1                     | 2           | 2           | 3           | 3           | 3           | SP           |
| ScituateConservation | 7/2/2014  | SC 120      | 89                          | 0                     | 1           | 2           | 3.5         | 4           | 4.5         | SA SP        |
| ScituateConservation | 7/2/2014  | SC 120      | 72                          | 5                     | 7           | 10          | 13          | 16          | 17          | Panne SA     |
| ScituateConservation | 7/2/2014  | SC 120      | 36                          | 0                     | 3           | 5           | 6           | 7           | 8           | SA           |
| ScituateConservation | 7/30/2014 | SC 120      | 1.2                         | 0.5                   | 1.5         | 2.5         | 4           | 4.5         | 5           | SA           |
| ScituateConservation | 7/30/2014 | SC 120      | 51.3                        | 0                     | 4           | 6           | 6.5         | 9           | 10.5        | SA SP        |
| ScituateConservation | 7/30/2014 | SC 120      | 70.9                        | 3                     | 8           | 9           | 9           | 10          | 10          | Panne/SA     |
| ScituateConservation | 7/30/2014 | SC 120      | 88.6                        | 0.5                   | 0.5         | 1           | 1.25        | 3.5         | 3.5         | SA SP        |
| ScituateConservation | 7/30/2014 | SC 120      | 119                         | 0                     | 1           | 1           | 1.5         | 1.5         | 1.5         | SP SA        |
| TruantsIsland        | 7/2/2014  | TI 96       | 27                          | 0                     | 0.5         | 0.5         | 0.5         | 1           | 1           | SP JG        |
| TruantsIsland        | 7/2/2014  | TI 96       | 12                          | 0.5                   | 1           | 2.5         | 3.5         | 5           | 6           | SP SA        |
| TruantsIsland        | 7/2/2014  | TI 96       | 1                           | 0                     | 1           | 6           | 3           | 3.5         | 9           | SA           |
| TruantsIsland        | 7/31/2014 | TI 96       | 8.8                         | 0                     | 0.5         | 1           | 1           | 2           | 2.5         | SP JG        |
| TruantsIsland        | 7/31/2014 | TI 96       | 24.95                       | 2.5                   | 8           | 10          | 12          | 14          | 14.5        | SP SA JG     |

**Table 3. Root Core Data**

| Marsh ID             | High vs Low Marsh | Date Collected | Time Collected | Latitude  | Longitude | Final weight (g) |
|----------------------|-------------------|----------------|----------------|-----------|-----------|------------------|
| <b>JRWA</b>          |                   |                |                |           |           |                  |
| Harbor Master        | High              | 10/2/2014      | 11:32          | 41 59.861 | 70 42.620 | 12.98            |
| Harbor Master        | High (DUP)        | 10/2/2014      | 11:34          | 41 59.861 | 70 42.620 | 13.00            |
| Harbor Master        | Low               | 10/2/2014      | 11:45          | 41 59.864 | 70 42.599 | 14.24            |
| Callista             | High              | 9/22/2014      | 11:20          | 41 59.573 | 70 42.779 | 7.70             |
| Callista             | Low               | 9/22/2014      | 11:26          | 41 59.590 | 70 42.757 | 7.03             |
| JonesRiverLanding    | High              | 9/24/2014      | 13:38          | 41 59.793 | 70 43.362 | 12.50            |
| JonesRiverLanding    | Low               | 9/24/2014      | 13:45          | 41 59.799 | 70 43.362 | 6.49             |
| L. Knife             | High              | 9/22/2014      | 12:06          | 41 59.656 | 70 43.058 | 17.03            |
| L. Knife             | Low               | 9/22/2014      | 12:10          | 41 59.667 | 70 43.048 | 9.79             |
| <b>NSRWA</b>         |                   |                |                |           |           | 0.00             |
| CoastGuard           | High              | 9/17/2014      | 10:26          | 42 07.591 | 70 41.587 | 14.45            |
| CoastGuard           | Low               | 9/17/2014      | 10:34          | 42 07.611 | 70 41.557 | 12.83            |
| Driftway             | High              | 9/22/2014      | 13:47          | 42 10.268 | 70 43.125 | 14.81            |
| Driftway             | Low               | 9/22/2014      | 13:54          | 42 10.240 | 70 43.170 | 8.19             |
| Rexhame              | High              | 9/17/2014      | 9:31           | 42 06.565 | 70 40.751 | 20.60            |
| Rexhame              | Low               | 9/17/2014      | 9:55           | 42 06.573 | 70 40.15  | 14.05            |
| ScituateConservation | High              | 9/17/2014      | 11:04          | 42 10.586 | 70 44.267 | 9.20             |
| ScituateConservation | Low               | 9/17/2014      | 11:11          | 42 10.539 | 70 44.291 | 11.50            |
| TruantsIsland        | High              | 10/2/2014      | 9:26           | no data   | no data   | 13.99            |
| TruantsIsland        | Low               | 10/2/2014      | 9:32           | no data   | no data   | 16.50            |
| Chittenden           | High              | 9/22/2014      | 14:20          | 42 08.985 | 70 47.154 | 14.75            |
| Chittenden           | Low               | 9/22/2014      | 14:24          | 42 08.984 | 70 47.155 | 10.85            |